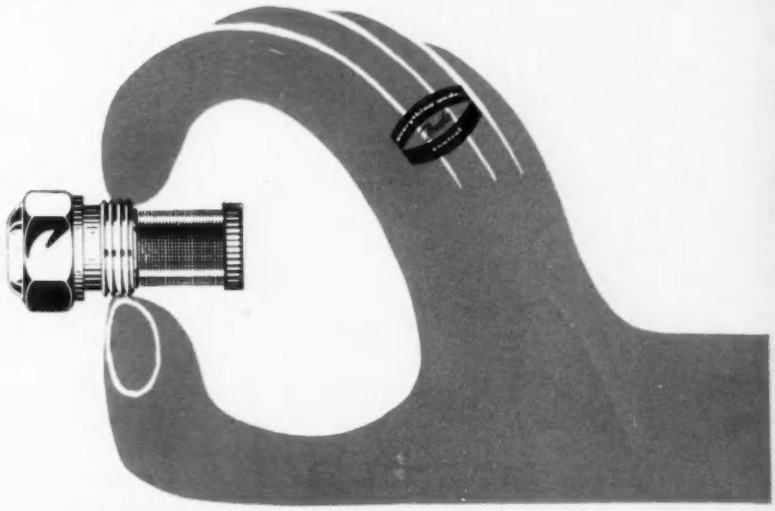
ENGINEERING AND
BOILER HOUSE REVIEW

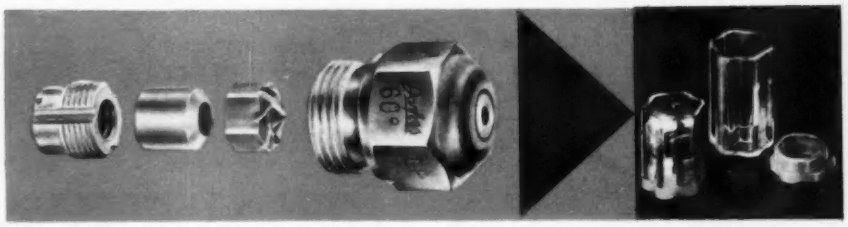
ESTABLISHED 1899

TWO SHILLINGS & SIXPENCE

VOL. 74 NO. 7 • THE PIONEER STEAM JOURNAL • JULY, 1959

A Danfoss
OIL NOZZLE
saves both user
and service engineer
a lot of trouble





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Type OD for high-pressure oil burners and Type 30D for low-pressure burners— are nozzles you can depend on !

They are made of wear- and acid-resisting chrome-nickel steel to avoid a gradual increase in the quantity of oil on account of wear and corrosion.

Type OD is available for four different spray angles: 30°, 45°, 60° and 80°, and for capacities from 0.63 US.GPH to 32 US.GPH.

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Nozzle holders for all types.

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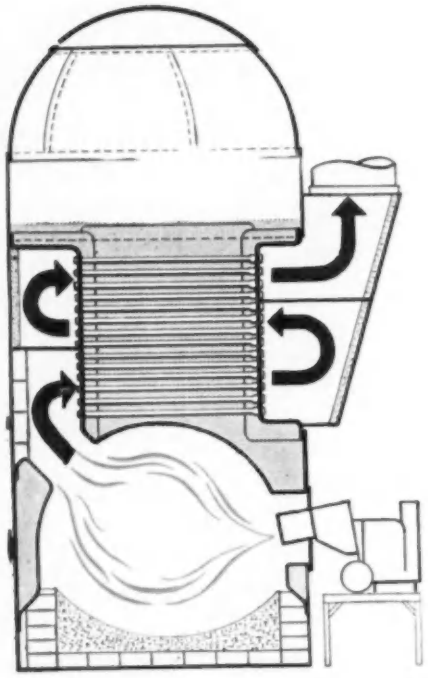
A HIGH EFFICIENCY VERTICAL BOILER with—



- ★ **All the advantages of the well known Cochran design and construction.**
- ★ **Multi-pass design giving over 80% efficiency on the gross calorific value of the fuel.**
- ★ **Fully automatic controls with pressurised, modulating burner.**
- ★ **Readily convertible to solid fuel.**
- ★ **The important advantage, usually associated with "packaged" boilers—every boiler is steam tested and has controls set for optimum efficiency at the Works before despatch.**
- ★ **AND the Series II design gives the maximum economy of floor space**—in fact it requires only about half that required for a modern horizontal boiler of equal capacity.

All these advantages are achieved without sacrificing the essential design features of Cochran Vertical Boilers which have, over the years, shown supreme qualities of reliability and durability.

THESE BOILERS ARE ALREADY AVAILABLE IN RATINGS FROM 1,750 to 8,300 lbs. hr. from and at 212 F and an early extension of the range is planned. The Standard Range of Cochran Vertical Boilers will continue to be available.

Leaflet C.B. 94 describes the Series II boiler.

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COCHRAN & COMPANY, ANNAN, LIMITED, ANNAN, DUMFRIESSHIRE, SCOTLAND, ANNAN 111
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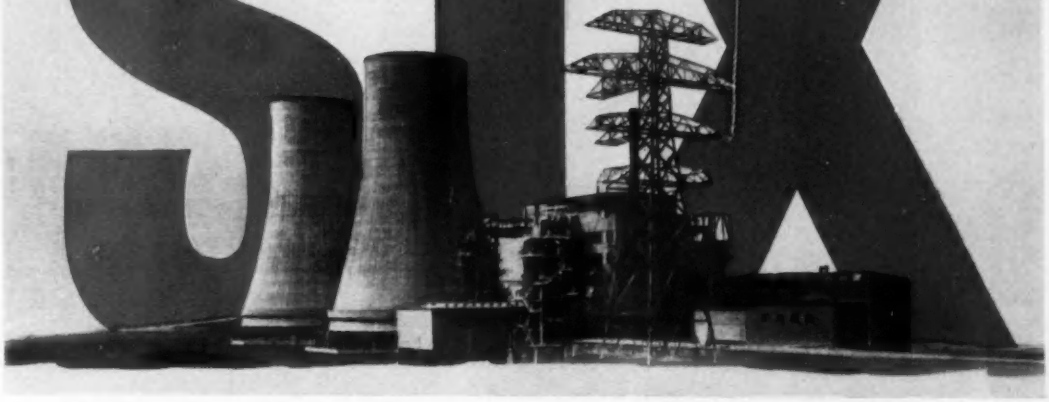
series II

TAS/CH670

PERMUTIT *in* SIX



Atomic Power Stations

Permutit have now obtained contracts for supplying "Deminrolit" plant to six Atomic Power Stations. This follows the successful installation of "Deminrolit" plant for providing feed water for heat exchangers at the world's first Atomic Power Station at Calder Hall. "Deminrolit" plant is but one of a complete range of plants designed and manufactured by Permutit to provide perfect feed water for heat exchangers and boilers of ALL types and pressures.

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2 CALDER HALL B
3 CHAPELCROSS
4 BRADWELL
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6 HUNTERSTON

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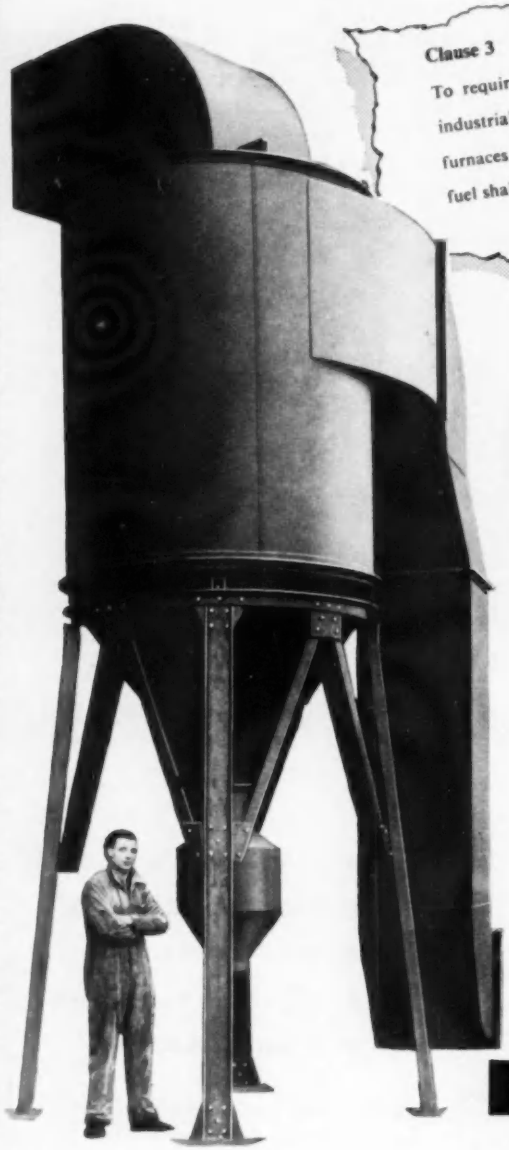
CLEAN AIR ACT 1956

Clause 3

To require that the emission of grit and dust from existing industrial furnaces shall be minimised and that new industrial furnaces burning pulverised fuel or large quantities of other solid fuel shall be provided with approved grit-arresting equipment.



Cyclone Patent Grit Arrester installed at Reading.

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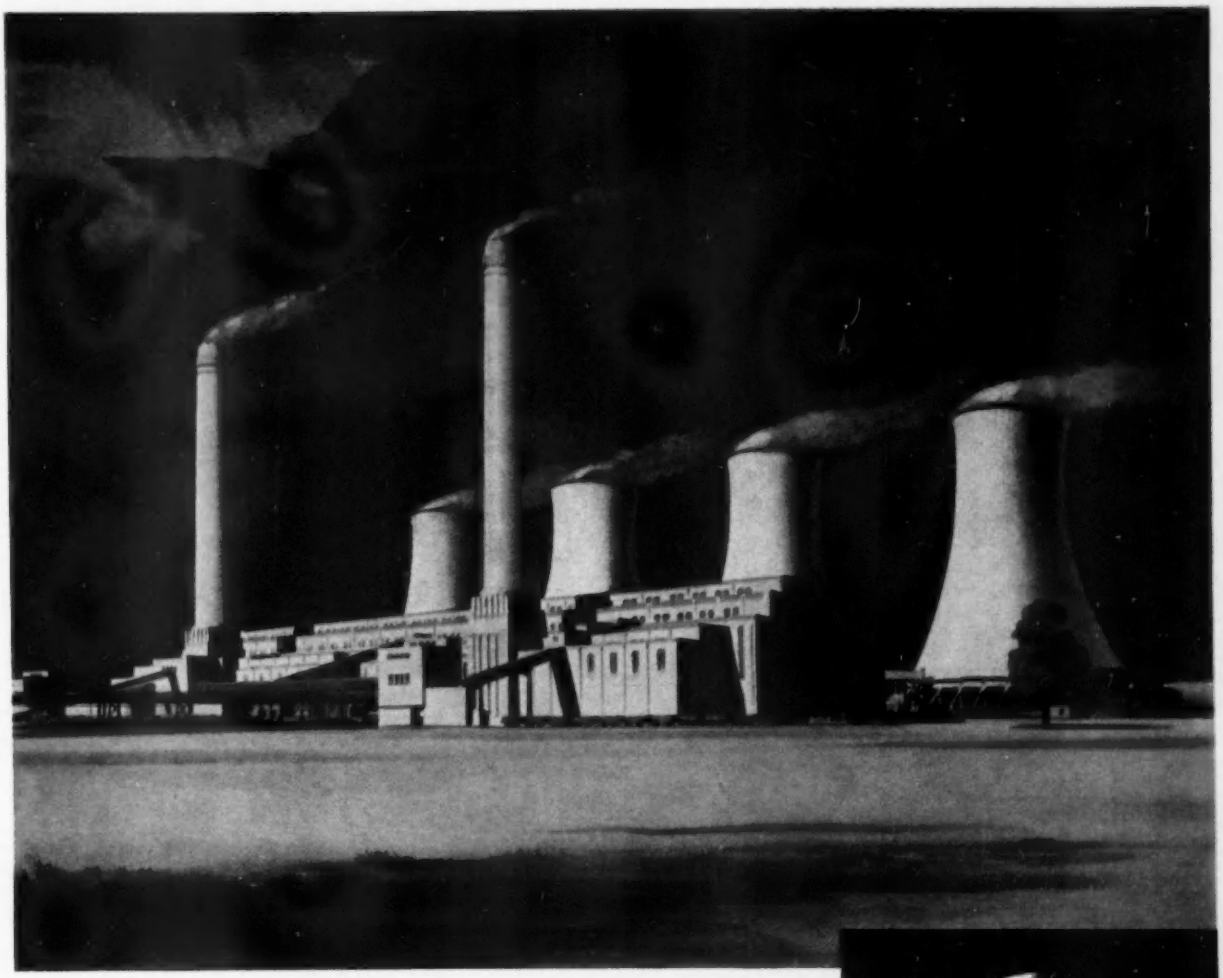

Oil burning efficiency means POWER . . .

Lucas has unrivalled knowledge of the burning of liquid fuels. This knowledge has been gained over years of research and development in world-wide applications, including installations in British Central Electricity Generating Board Stations.
A range of atomisers for oil burning appliances is now available and includes units suitable for flows of 0.5 gallons per hour to the largest boiler installations with flows up to 5,500 lbs./hr. Calibrated to handle fuel oils of 35 to 12,000 seconds viscosity suitably pre-heated at varying spray angles according to particular requirements.

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Twenty-one boilers, with a combined maximum continuous rating of 14,120,000 lb. per hour, have been designed for the Central Electricity Generating Board by Foster Wheeler Limited, and are now being installed by them in five power stations.
Since 1946, Foster Wheeler has been responsible for the design of no less than forty-eight boilers totalling 21,050,000 lb. per hour maximum continuous rating, for thirteen C.E.G.B. power stations—a notable contribution to Britain's post-war recovery programme and export drive.

THESE POWER STATIONS HAVE SOMETHING IN COMMON

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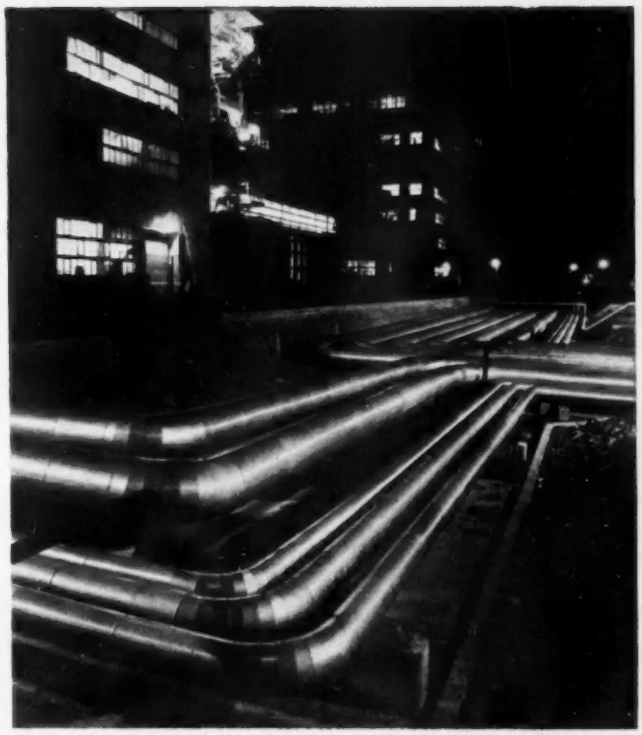

Steam, feed and CO_2 pipework in trenches with heat exchangers in background.

S&L PIPEWORK FOR CHAPELCROSS

We are the main contractors for the high and low pressure pipework at Chapelcross nuclear power station. Our contract includes the design, manufacture and installation of the steam feed, CO_2 and service water pipework.

In addition we have supplied over 250 miles of E.R.W. steel tubes for the heat exchangers.

CONSULTING ENGINEERS: MERZ & McLELLAN.

The illustrations are reproduced by courtesy of The United Kingdom Atomic Energy Authority, and of 'Nuclear Engineering'.

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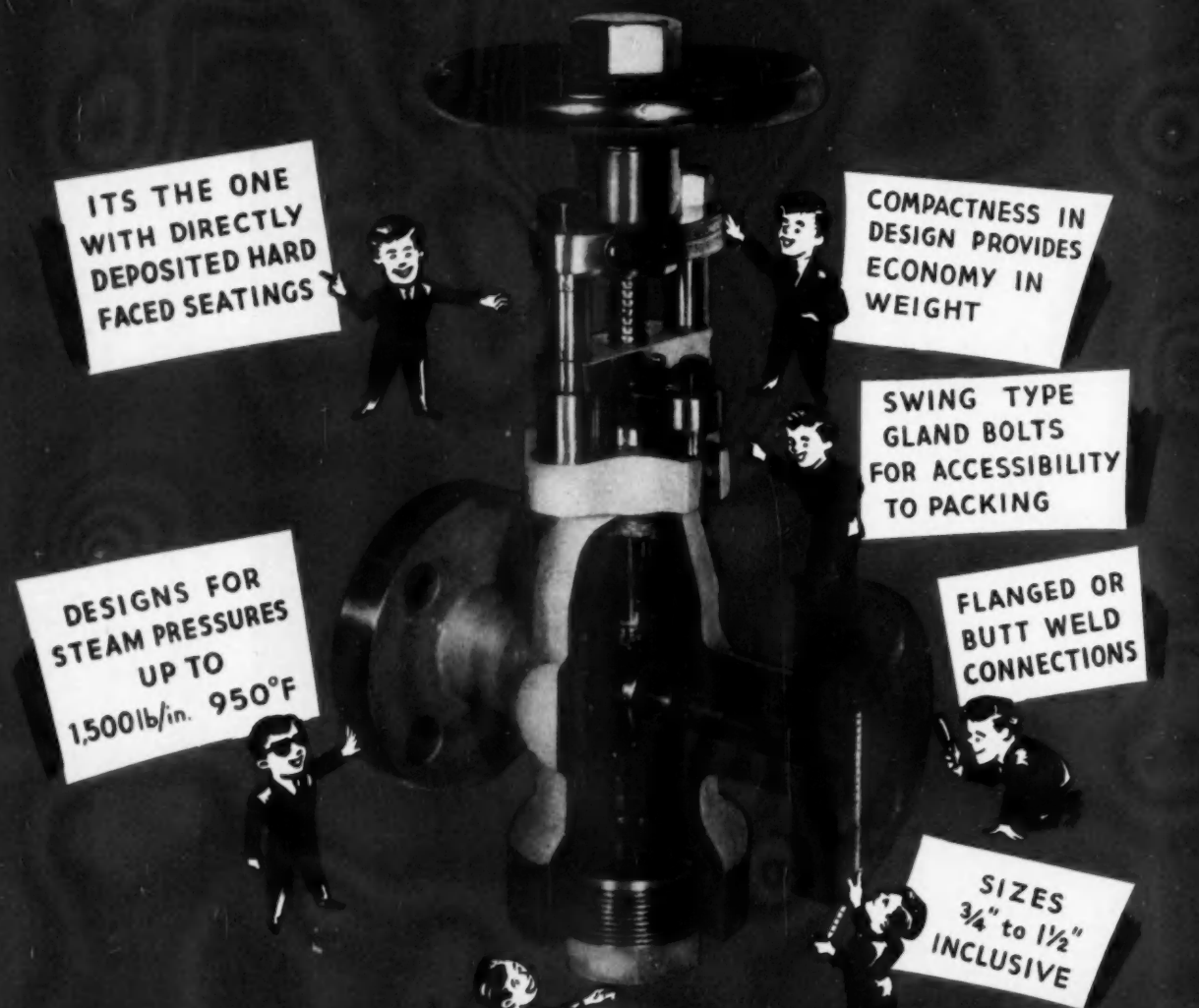
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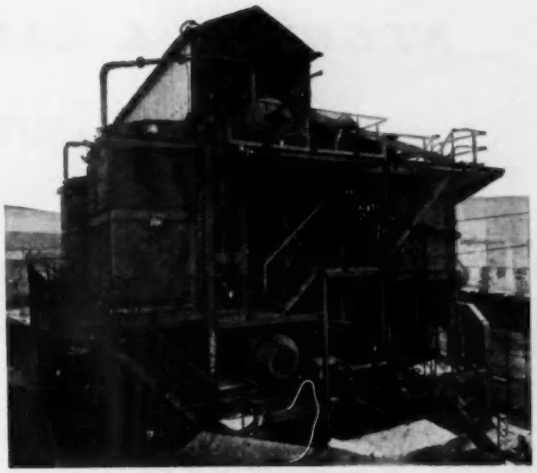
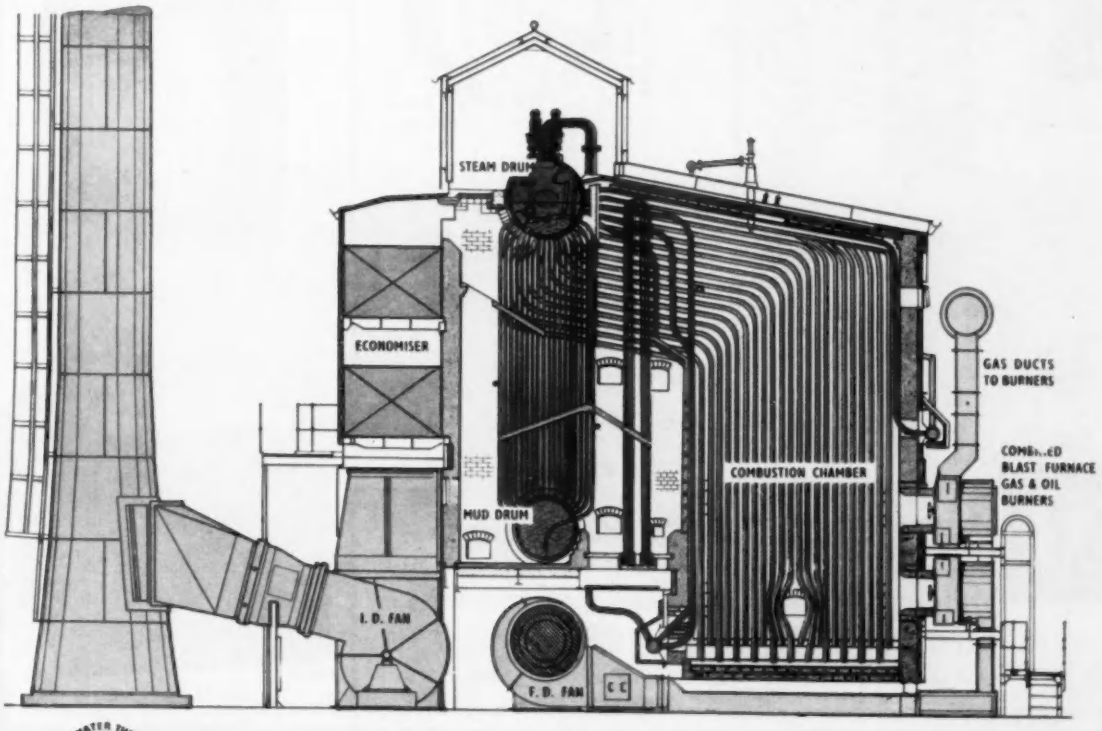
JOHN THOMPSON 'TWO-DRUM'

WATER TUBE BOILERS

The John Thompson 'Two-Drum' boiler is basically a water tube unit which can be supplied for solid, liquid or gas firing. Water walls are used and these reduce brickwork maintenance and cut radiation losses, whilst providing flexibility and rapid response to increased steam demands. The combustion chamber design is such that low heat release rates are attained with relatively small furnace areas. Particular care has been given to circulation and a system of internal baffles is arranged to give high steam purity. Adequate water storage capacity is ensured by the large single bank of tubes and its associated downcomers together with the water walls and their independent feeding circuits. The installation at Stewarts and Lloyds consists of two John Thompson 'Two-Drum' boilers each with an M.C.R. of 50,000 lb./hr. on blast furnace gas or 75,000 lb./hr. on oil firing. The working pressure is 450 lb./sq. in., and final steam temperature 750°F. Steam generated is used for turbo-alternators and turbo-blowers and extraction steam for works processes and space heating. John Thompson have long experience in manufacturing all types of boiler plant and are able to advise on the most suitable equipment for specific requirements.



Below is shown the arrangement of a John Thompson 'Two-Drum' boiler fired by blast furnace gas or oil at Messrs. Stewarts and Lloyds, Bilston. Above: one of the boilers is seen during erection.



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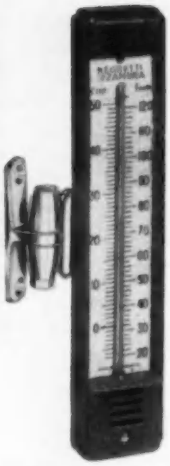
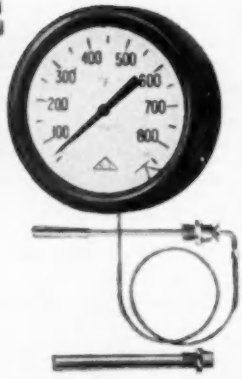


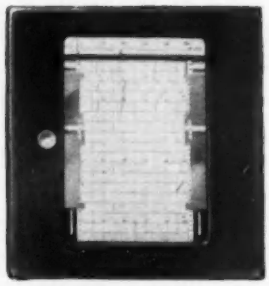
Room Thermometer
with plastic case

Brass-cased Tank and
Pipe Thermometer

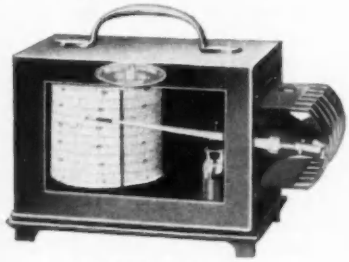
4" Mercury-in-steel
Dial Thermometer,
Rigid Stem Type



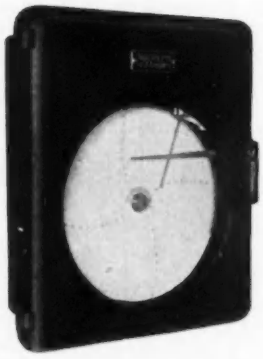
Distance-type Mercury-in-
steel Dial Thermometer



Resistance Thermometer
Recorder



Bi-metallic Recording
Thermometer



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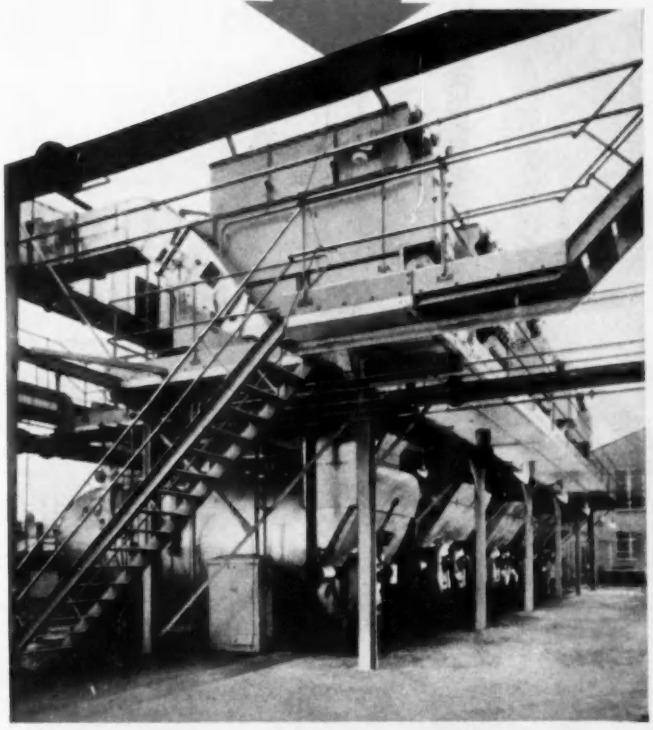
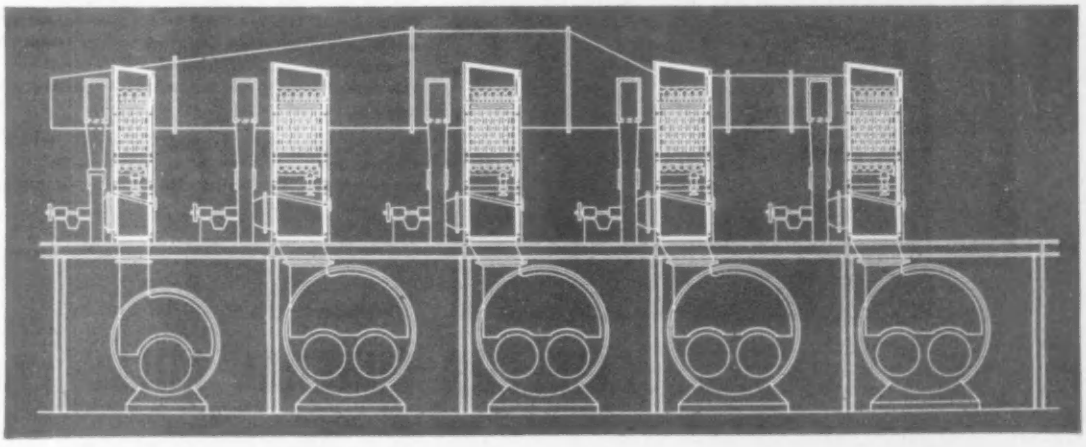


The Paints Division of Imperial Chemical Industries Limited of Slough operates an outdoor boiler plant, consisting of five John Thompson Economic boilers, four of 13,000 lb/hr each and one of 7,000 lb/hr. oil-fired, designed working pressure 120 p.s.i. Mounted above each boiler is a Green's Premier Diamond Type 25 Economiser, the general arrangement being as shown below.



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DOHMseal, applied to existing refractory linings by brush or to new linings by the "Dipped Brick" technique, forms a tough resistant glaze that retards the build-up of Carbon and Slag and extends the "maintenance free" life of the lining.

These undesirable deposits will eventually form but DOHMseal ensures their easy removal without damage to the refractory lining.

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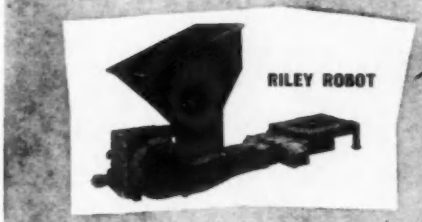

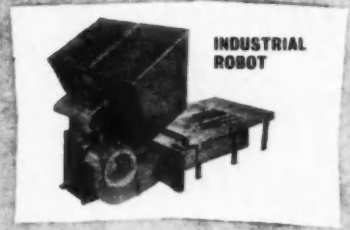

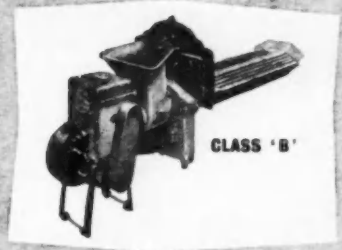

IT IS AN OFFENCE TO EMIT DARK SMOKE

Under the Clean Air Act it is now an offence to emit dark smoke. The problem of ensuring smokeless combustion within the meaning of the Act without costly conversions can be solved by the installation of Riley Chain Grate or Under-feed Mechanical Stokers. Write for full technical information.

all these RILEY STOKERS provide smokeless combustion from small bituminous coal

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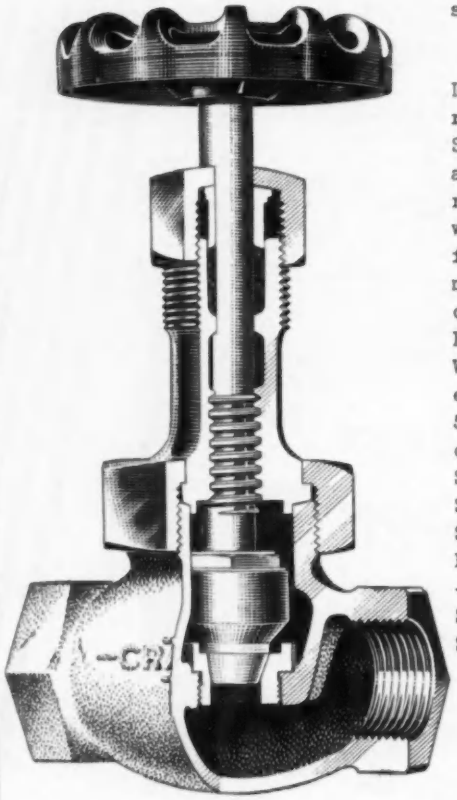
BULLETIN ON CRANE BRONZE GLOBE VALVES

...featuring the D46, with renewable Nickel Alloy Disc and stainless steel seat ring.



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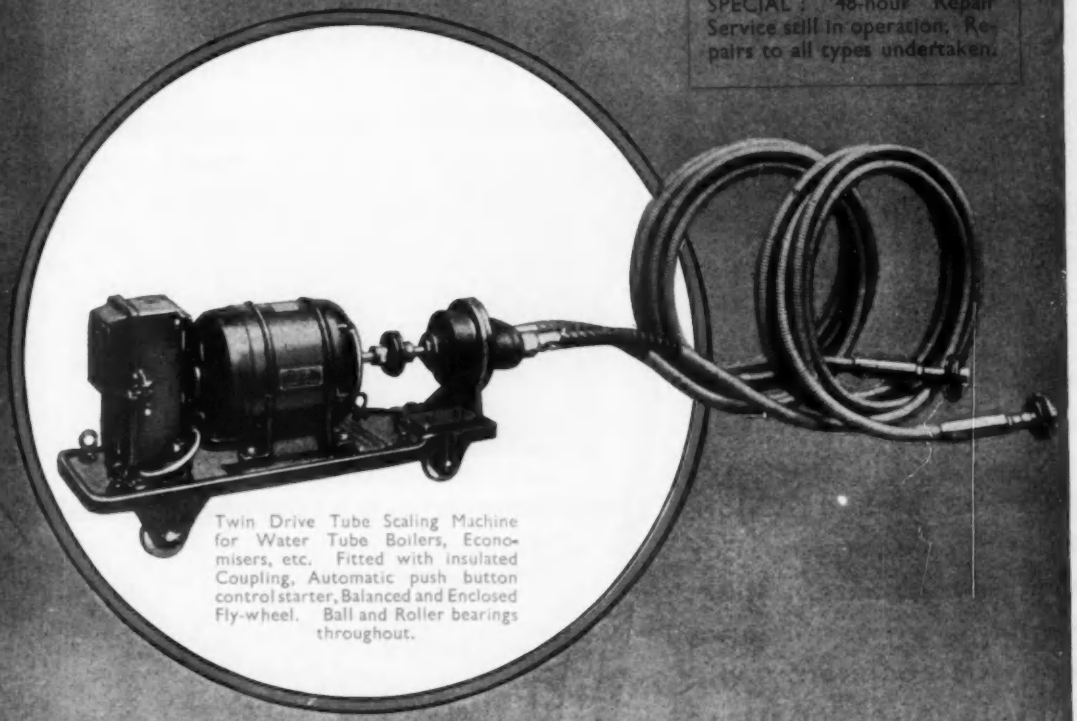

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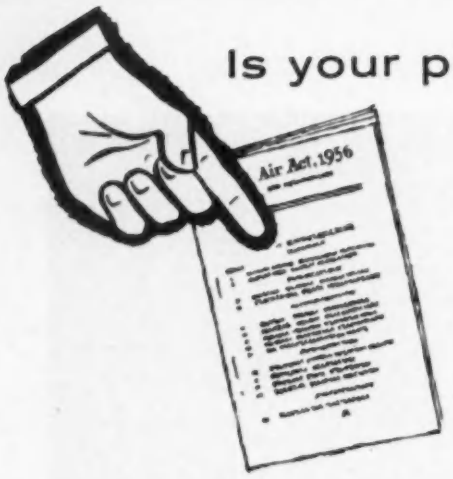

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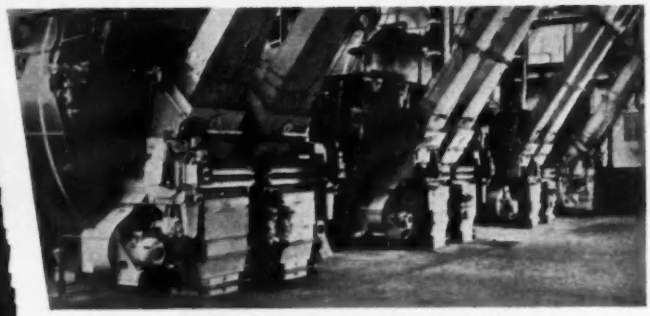
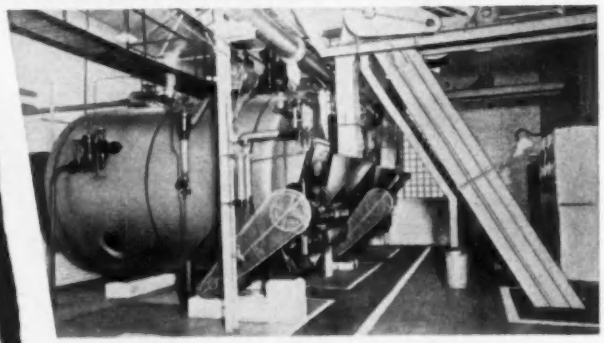
With the CHAIN GRATE and "LOW RAM" Stokers for the firing of shell type and small water tube boilers Bennis offer two machines which give not only freedom from legislative action but a new economy. For smokeless combustion, higher thermal efficiency and fuel economy with maintenance costs reduced to a minimum, the answer is clearly BENNIS.



Bennis Chain Grate Stokers fitted to Economic boilers.



"Low Ram" Stokers fitted to Ruston & Hornsby Horizontal "Thermax" Economic boilers.

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The shortest course of action is to ask for our two Information Sheets about air in steam plant. If what they say seems to make sense, you might even be encouraged to see what we have to say about other unprofitable aspects of steam usage. There may even be one or two of these which you haven't thought of: if we can help to get to the root of some of your troubles, we'll only be too happy.

By the way, air in hot water plant doesn't make sense either.

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A section of copper piping showing heavy scale deposit

The same section after treatment with Starit

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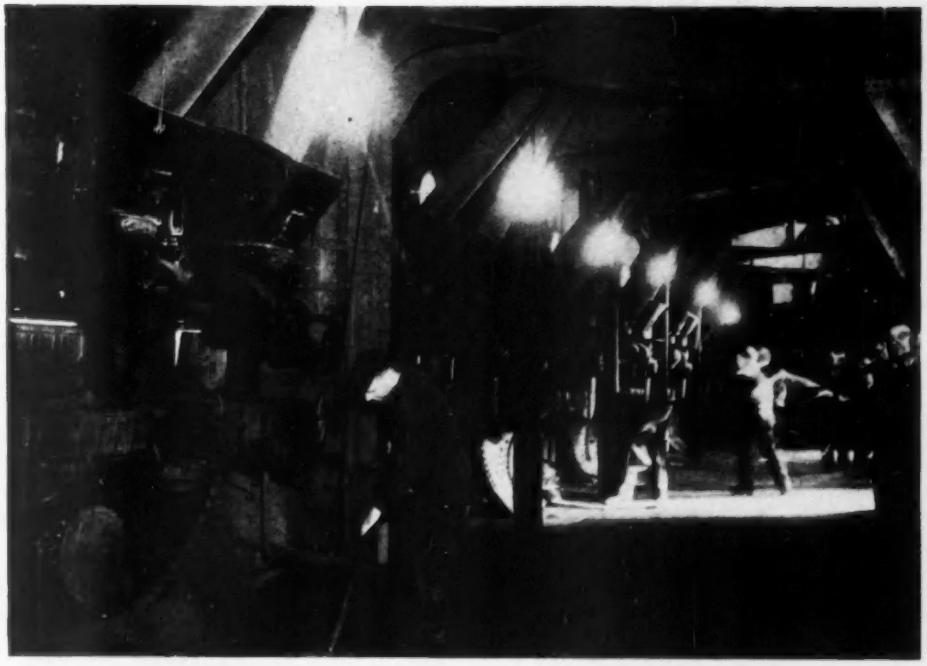

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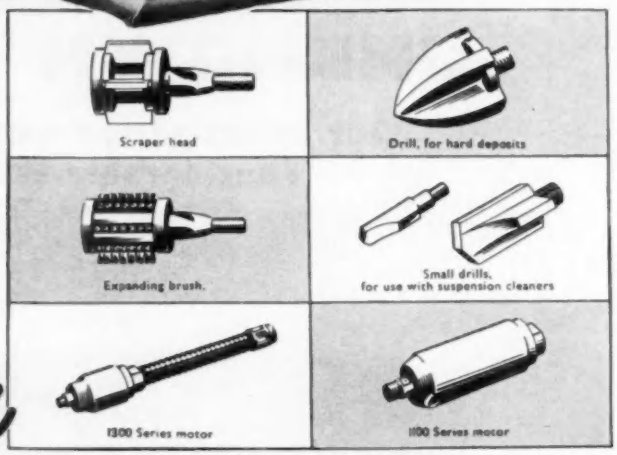

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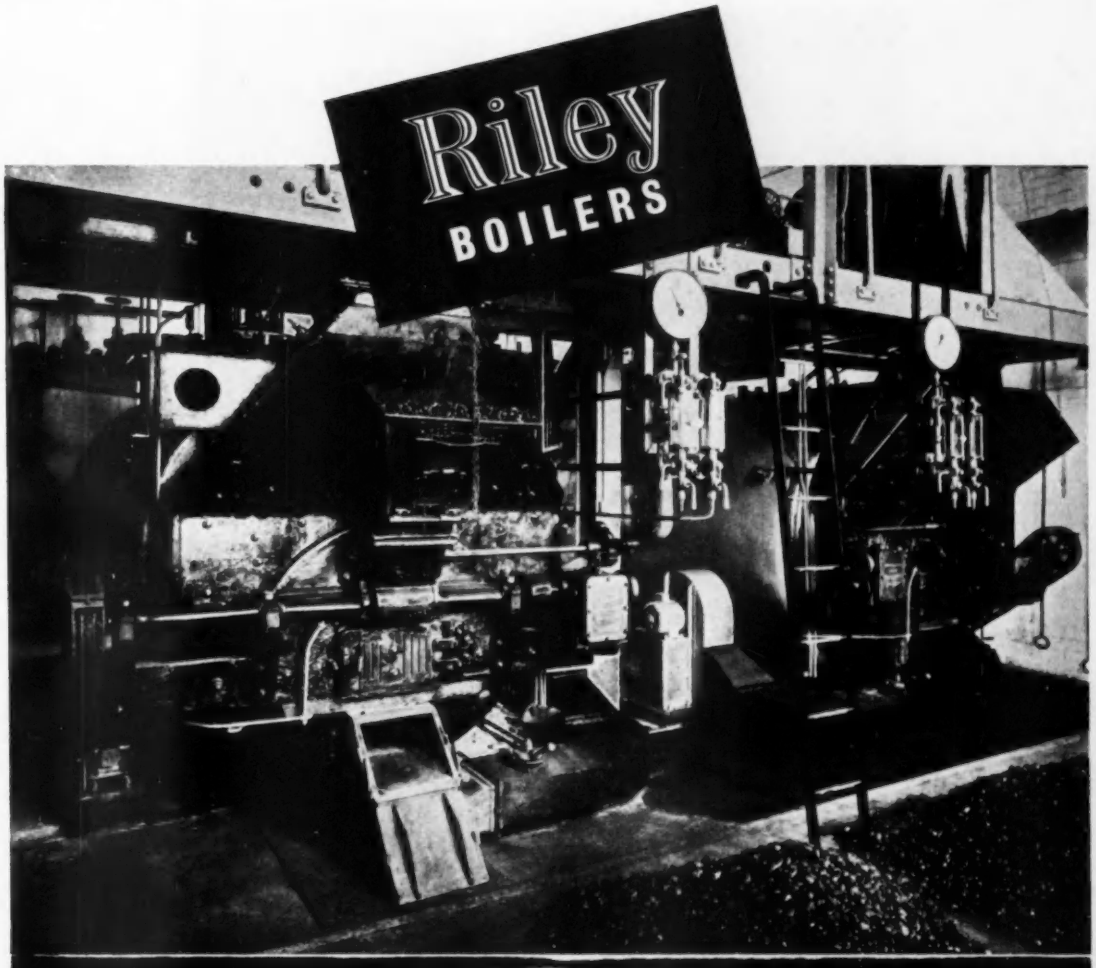

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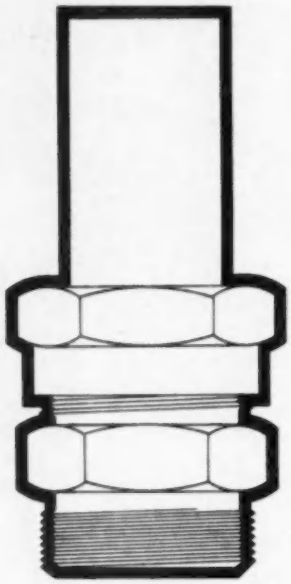

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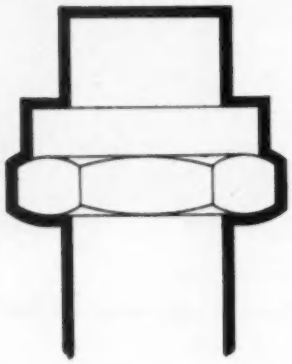

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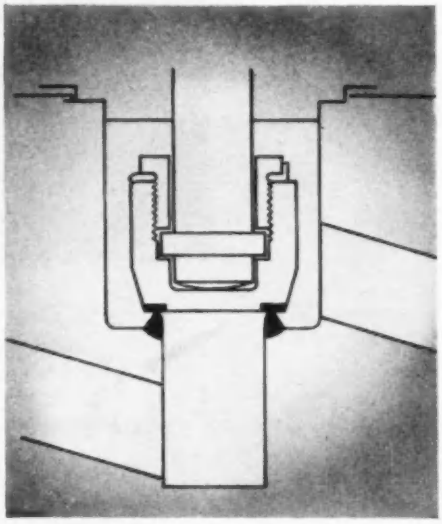

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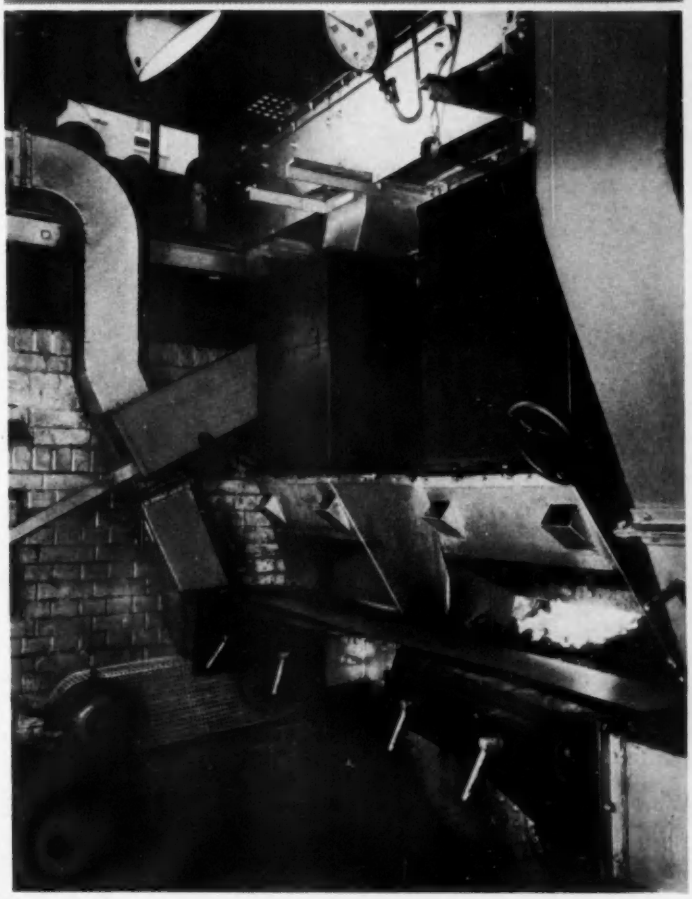

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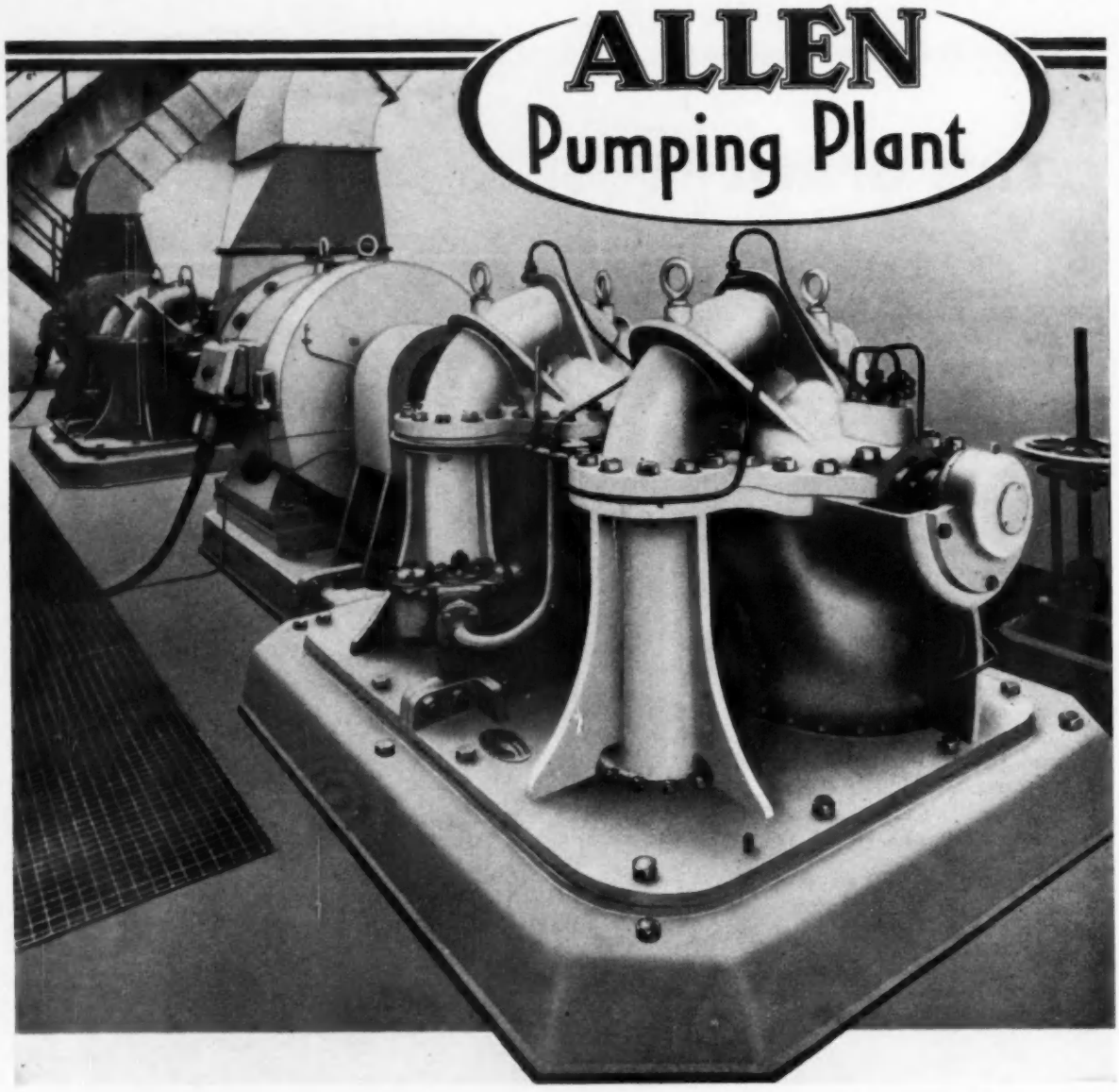

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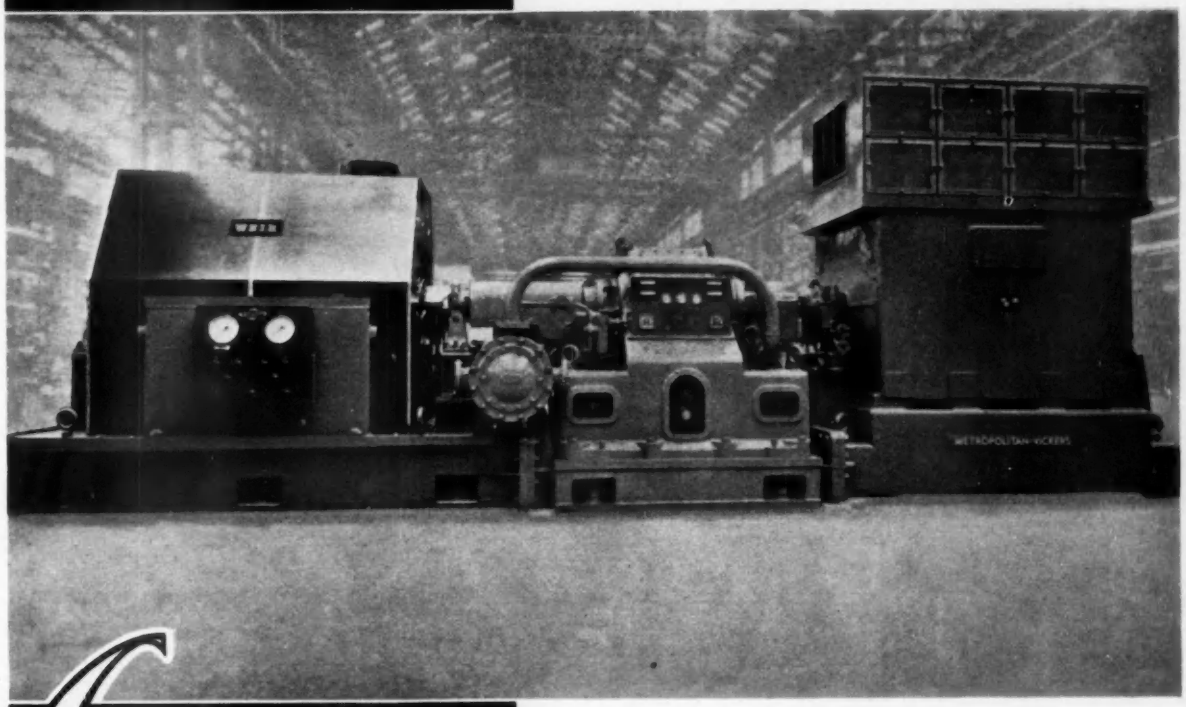

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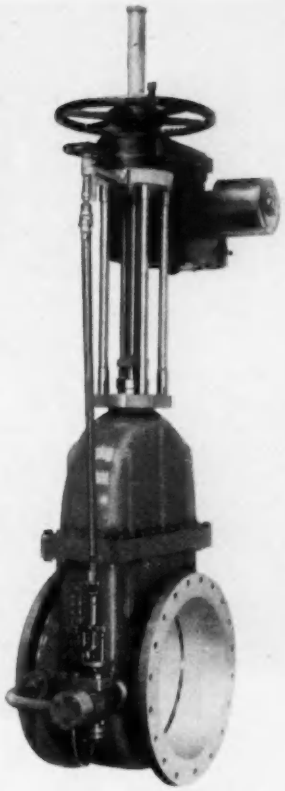

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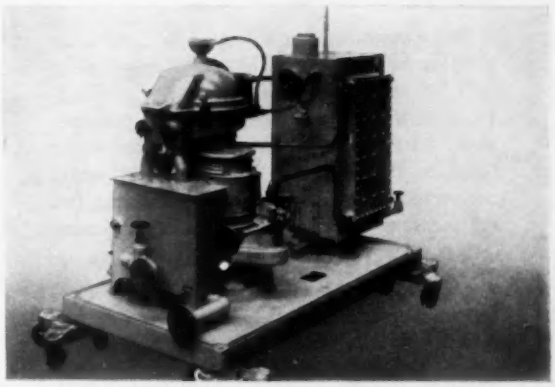

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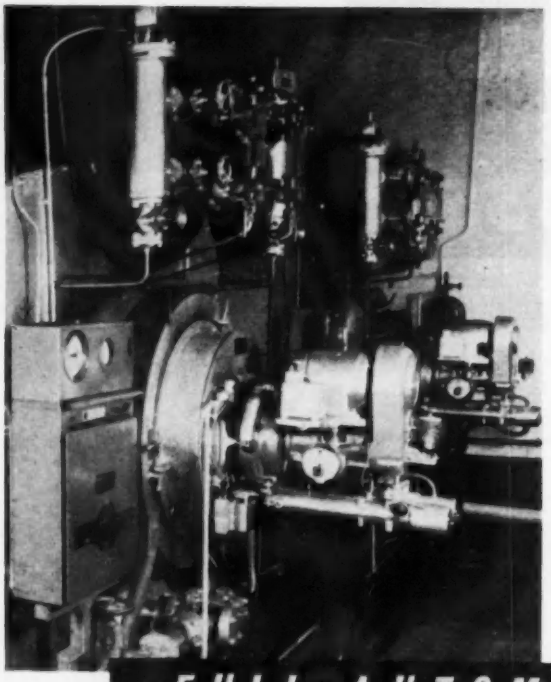

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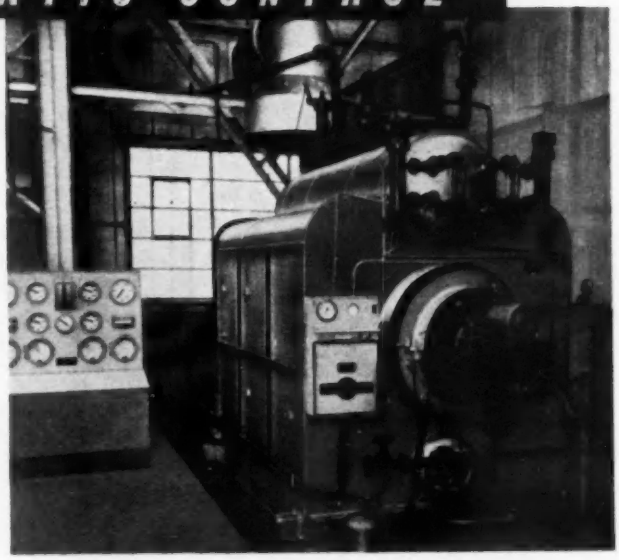

These high efficiency boilers are manufactured in fourteen sizes capable of supplying hot water or steam, for power, processing or heating. Evaporation ratings are from 2,500 to 17,000 lb./hr., with larger sizes up to 33,000 lb./hr. The ratings are from and at 212 deg. F. Two standard pressure ranges are available:

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The automatic burner fitted is capable of burning heavy fuel oil having viscosities up to 3,500 seconds Redwood No. 1 at 100 deg. F., or of burning gaseous fuels or a combination. A balanced pressure is maintained in the furnace at all times by means of cross connected controls between an induced fan on the rear of the bed plate and a forced draught fan on the main casing.

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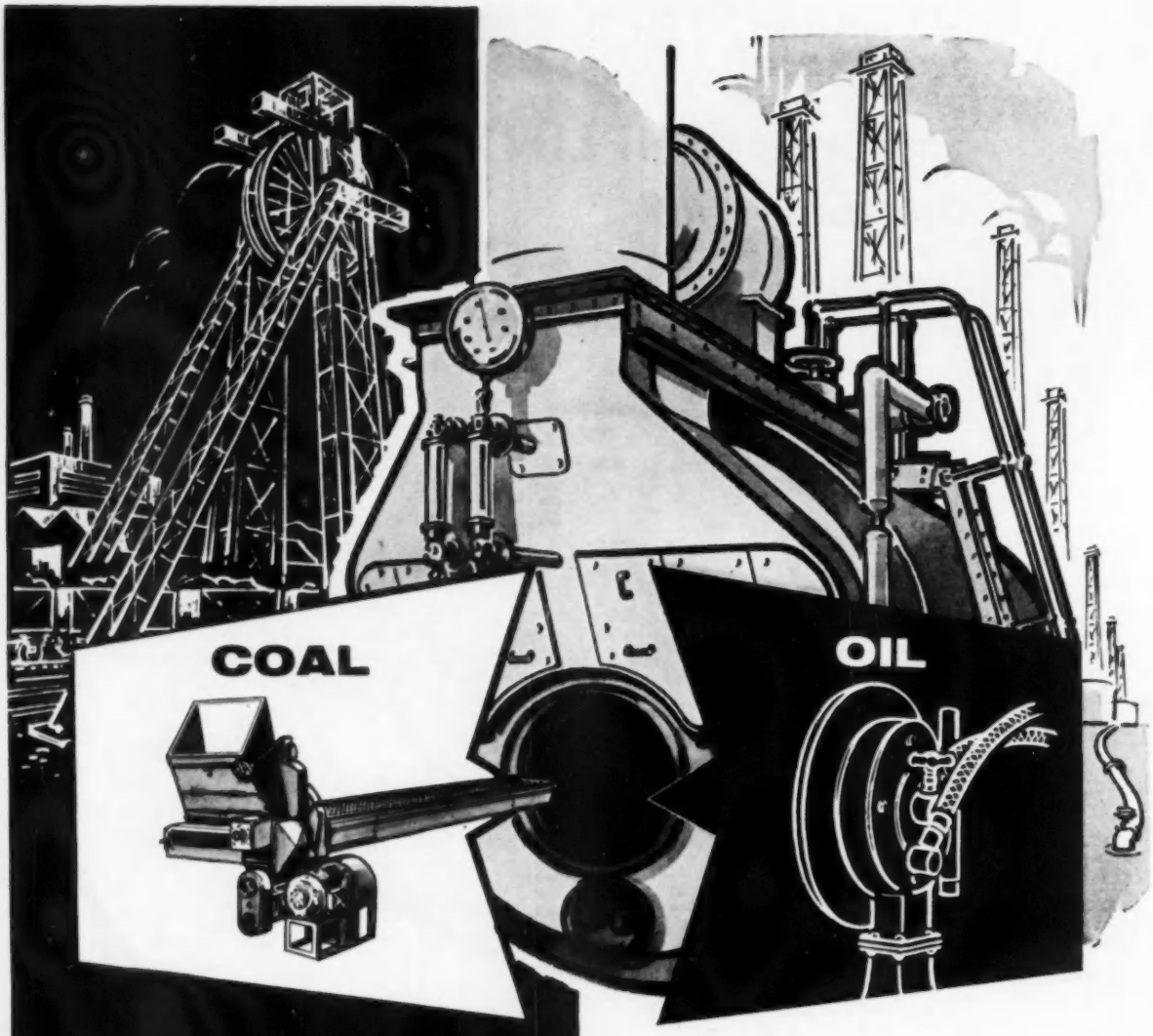

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

JULY 1959

VOLUME 74. No. 7

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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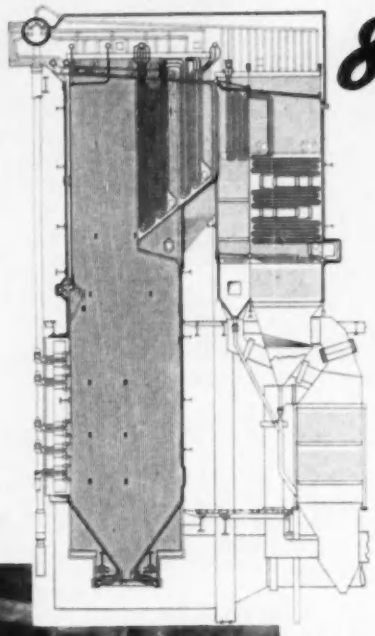
Four 860,000 lb./hr. boilers



(Right) Boiler arrangement. (Below) Drum-level view at an advanced stage of erection. The fusion-welded drum weighs over a hundred tons.

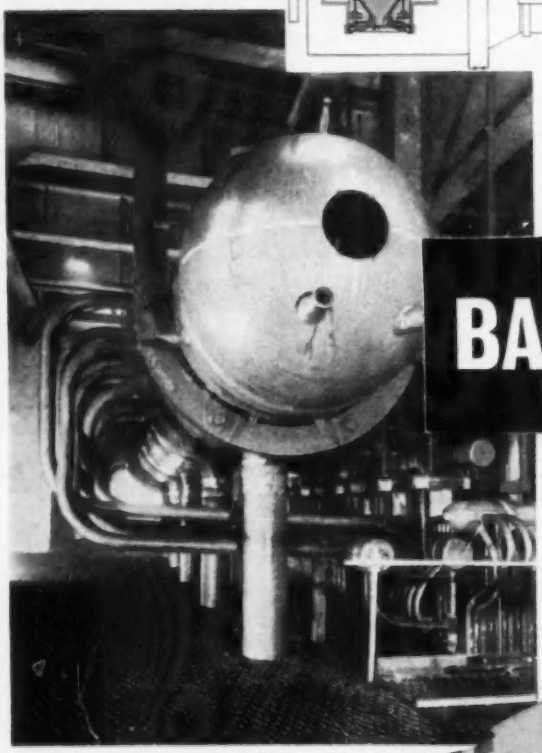
Largest-capacity boiler unit operating in Great Britain is the first of the four 860,000 lb./hr. (120 MW) Babcock boilers at Blyth A power station (N.E. Division, C.E.G.B.). These are pulverized-coal-fired Radiant-type units for steam conditions of 1600 lb./sq.in. S.O.P., 1010°F, with reheat to 1005°F.

Blyth 'A' will undoubtedly rank among the highest efficiency installations in the country; the station returning the highest overall efficiency at present being Castle Donington, which also is equipped entirely with Babcock boiler plant.

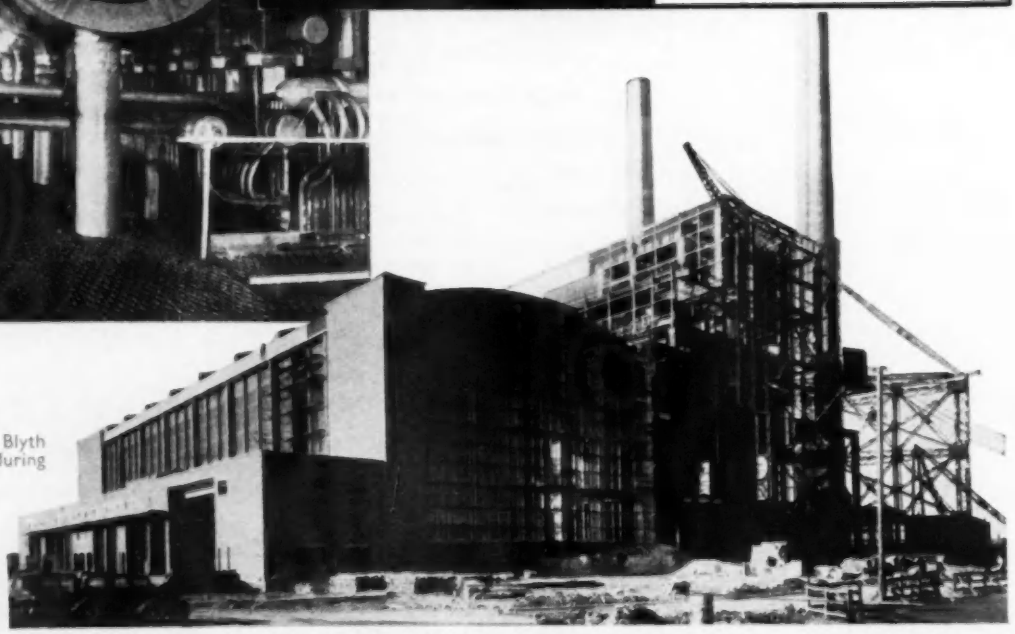
Modern dust-handling at Blyth.

The whole of the dust from precipitator hoppers and other collecting points will be handled by the Babcock low-pressure pneumatic system, using Air-Slides and Fuller-Kinyon pumps, delivering to storage bunkers and thence to mixer-conveyors, for barge-disposal. This will be the largest of many installations using this outstandingly effective system.

Consulting Engineers: Merz and McLellan.



BABCOCK at BLYTH



General view of Blyth 'A' power station during construction.

BABCOCK & WILCOX LIMITED, BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1

Engineering and BOILER HOUSE REVIEW

JULY 1959

VOLUME 74 No. 7

A RESTRICTIVE TRADING AGREEMENT

A FEW weeks ago we were invited to attend an informal conference arranged by the Water-Tube Boilermakers' Association, when the Trading Agreement under which the Association and the member companies work was explained, and the present and future prospects of the Water-Tube Boilermaking industry were discussed.

The Trading Agreement came before the Restrictive Trade Practices Court on June 22nd, for that court to decide whether or not the Agreement was acceptable under the Restrictive Trade Practices Act of 1956. Details of the Agreement, which the Association brought to the notice of the Registrar of the Court, and which the Registrar decided the Court would have to pass judgement, or rather pronounce upon, differ in numerous respects from arrangements which were originally agreed upon when the Association was formed in 1933, when markets for the products of manufacturers of Water-Tube boiler plant and associated auxiliary equipment were extremely limited, and when cut-throat competition between boilermakers was having very adverse results.

At the above-mentioned Conference both Mr. J. B. Woodeson, O.B.E., chairman of the Water-Tube Boilermakers' Association (and of Clarke, Chapman & Co. Ltd.) and Sir Edward Thompson, J.P., past president of the Association (and chairman and joint managing director John Thompson Limited) explained that the original agreement may have appeared to have some of the attributes of a "price-ring." But in February, 1957, a new agreement was reached, and from that date six of the largest boiler plant manufacturers have worked to it. There are several boiler-making firms in this country who are not members of the Association —one or two of these firms being capable of constructing plant as large as any of the six Association member companies could supply.

We understand that under the present agreement, all six member firms prepare quite independent tenders for any contract in which they may be interested. Thereafter, a meeting of representatives of the member firms is held, and before any details of the various tender figures are revealed, there is a discussion at the meeting to consider whether there are any special reasons why the contract in question should go to any particular member. Included among such reasons may be a shortage of work in that member's establishment, or long-standing commercial and friendly relations with the client whereby intimate knowledge of the client's exact requirements and plant operating methods has been acquired, and so forth. At the end of the discussion one member firm is named what the Association defines as the "preferred" winner of the contract. At this point details of all six tenders are made known and carefully evaluated—the "preferred" firm being given the opportunity to bring its price down to equality on the basis of equal value given for price received (this being in accordance with evaluation by the Association) with the figure submitted by the lowest bidder. All the tenders are then forwarded to the client for scrutiny.

From this procedure it will be seen that the client is given two low tender figures from which to choose, viz.:—the original lowest bid, and the bid of the "preferred" member—assuming that member has reduced his bid to the equality figure. In addition, the client is, of course, for any reasons of his own, free to select a higher tender.

In the boiler-making industry, as indeed in certain other industries in which both home and foreign competition has to be met, and in which rapid developments in design, construction, and methods of operation are vital, there is surely a limit to the lengths which price competition can go before getting out of hand.

But apart from the question of actual tendering, there is the highly important matter of research and development—a matter which is foremost in the activities of the Association—the members of which, like the members of similar associations, need to spend, and, in fact, do spend, large amounts of money annually on research and development—this applies to both technological research and market research. An excellent example of the former, for which the Water-Tube Boilermakers' Association was, and still is, largely responsible, is the major research project relating to the fundamentals of circulation theory in high-pressure boilers and certain other types of evaporative heat-exchangers, being carried out by the Department of Engineering in the University of Cambridge. Following a visit to Cambridge, we made extensive reference to these research activities in the August, 1957 issue of this journal.

Were there cut-throat competition among the member companies forming the Association, it is obvious that both the pooling of knowledge, and the pursuit of any form of organised research and development would suffer, either in times of boom or recession.

However, the Restrictive Trade Practices Court carefully investigated the whole position and gave its favourable decision on July 31st. In approving the agreement of the Water-Tube Boilermakers' Association, it appears that the Court has shown a realistic appreciation of the national importance of this great industry and, in particular, of its achievements in the field of overseas trade.

The Association points out that its over-riding concern is to give the maximum service to its customers throughout the world, and the Court by its judgement has ensured that there will be no deterioration in the standards which the industry has set itself.

Points and Pointers

COAL-BURNING APPLIANCES IN SMOKE CONTROL AREAS

The Ministry of Housing and Local Government announced on July 16th that coal-burning furnaces fired by mechanical stokers which were installed on or after December 31st, 1956, are to be given a general exemption in smoke control areas. The Coal Utilisation Council and the Combustion Engineering Association welcome the new exemption which will preserve a valuable market for British coal, without detracting in any way from the national policy to reduce pollution. In smoke control areas created under the Clean Air Act, 1956, many local authorities have already granted specific exemptions for mechanically-fired coal-burning furnaces, but the C.U.C. and the C.E.A. have been concerned at the lack of a general exemption. They had represented jointly to the Ministers of Power and of Housing and Local Government, that this situation was unsatisfactory, since industrialists and others were unlikely to install new mechanically-fired coal-burning plant, however efficient and smoke-free, in a smoke control area unless the local authority made an amending Order. The delays and uncertainties involved in this were a serious discouragement to the installation of modern and efficient coal-burning appliances, although these were capable of being operated as smokelessly as oil-fired appliances, which had already been granted a general exemption. The National Coal Board also welcome this decision by the Minister, as since the Clean Air Act was introduced, there has been considerable uncertainty about the use of bituminous coal in smoke control areas for fear of contravening the Act. Oil was at an advantage because oil-fired furnaces had been exempted by a previous order from the smoke control area provisions of the Act. The new order and circular to local authorities thus clarifies the position by exempting, or giving a clear lead on the exemption of coal-burning furnaces fired by mechanical stokers in smoke control areas. In these conditions, coal can be burnt with as much freedom from smoke as any other fuel. The National Coal Board, for their part, will make available supplies of suitable coals for those appliances.

NATIONAL INDUSTRIAL FUEL EFFICIENCY SERVICE

The sixth annual refresher course on Current Practice in Fuel Efficiency, and organised by the National Industrial Fuel Efficiency Service, is to be held at The Clarendon Laboratory, Oxford, from September 21st to 25th, 1959. The course is being arranged with the support of The Southern Regional Council for Further Education. This excellent N.I.F.E.S. annual refresher course is firmly established as the opportunity for works managers, works and plant engineers and members of the technical staffs of industrial firms and municipal and public undertakings to acquire up-to-date information and guidance on the economic use of fuel—so vital to increased efficiency and productivity. The course covers a wide range of subjects, and each of the lectures is presented by a speaker eminent in the special field to be covered, and who will pay particular attention to practical application. Where possible, lecture notes will be provided and will be issued two weeks before the course for prior study. Great importance is attached to the opportunity for questions and discussion following each lecture, and this is of particular value to members with special problems. The course is also a valuable medium for the exchange of experiences between members with a common aim—economy, efficiency and greater productivity. There will be 17 sessions which include three evening periods. The day sessions will be held in the Main Lecture Theatre of the Clarendon Laboratory, Parks Road. The evening sessions, which will be of an informal nature, will be held after dinner at Brasenose College. For resident members the registration fee covering the whole course, accommodation and meals from lunch on Monday, September 21st until lunch on Friday, September 25th, will be £15 15s. 0d. For non-resident members, the registration fee covering the whole course, coffee, lunch and tea daily from lunch on Monday September 21st to lunch on Friday, September 25th, will be £10 10s. 0d. No refund of fees can be made in respect of applications withdrawn later than September 7th, 1959. Particulars of the course and also application form for membership can be obtained from: The Course Secretary, Sixth Annual Refresher Course, National Industrial Fuel Efficiency Service, Ailsa House, 181, King's Road, Reading. Telephone: Reading 50831.

NEW D.S.I.R. LABORATORY

The new Warren Springs Laboratory of the Department of Scientific and Industrial Research at Stevenage, Herts., was officially opened by The Rt. Hon. Viscount Hailsham, Q.C., on June 29th, 1959. Work started on the site in September, 1957, and the movement of staff from the Fuel Research Station at Greenwich to the new establishment commenced in November, 1958. The laboratory has been designed to assist both Government departments and industry by research and development work over a wide field of science and technology. It has been equipped in particular for work on a pilot-scale. Some time ago the council of D.S.I.R. considered that the Fuel Research Station had largely fulfilled the aims in view when it was set up, and that current needs were satisfactorily catered for elsewhere. They, therefore, decided that when it became necessary to close down the Fuel Research Station and the transfer to Stevenage took place, a number of new programmes should be embarked upon. In fact, of the work carried out at Greenwich, only two programmes have, or will be, transferred to the new station; namely, research on the abatement of atmospheric

pollution, and on the synthesis of oils and chemicals from carbon monoxide and hydrogen by the Fischer-Tropsch process. Work on the Fischer-Tropsch process is already undertaken at Warren Springs, while that on atmospheric pollution will be transferred early next year. Two further subjects covered by the current research programme are (1) mineral processing and (2) chemical engineering research. The research programme is regularly considered by a steering committee, appointed by the research council, the members of which are:—Chairman: Sir Harry Jephcott, D.Sc., F.R.I.C., chairman of the Council for Scientific and Industrial Research, chairman, Glaxo Laboratories Limited; Members: Dr. R. Holroyd, M.Sc., deputy-chairman, Imperial Chemical Industries Limited; Mr. D. A. Oliver, C.B.E., M.Sc. (Eng.), director of research of the B.S.A. Group Research Centre; Sir Harry Melville, K.C.B., F.R.S., secretary, Department of Scientific and Industrial Research; and Mr. S. H. Clarke, C.B.E., M.Sc., director of the Warren Spring Laboratory.

AUSTRALIA'S BIGGEST STEAM TURBINES

The English Electric Co. Ltd. has been awarded a contract to build Australia's first 200 MW steam turbo-alternators. In a total contract worth £A4¾ million, negotiated by the company's Australian subsidiary, The English Electric Company of Australia Pty. Ltd., with the Electricity Supply Commission of New South Wales, the parent company will supply two 200-MW turbo-alternators valued at some £3 million sterling. The remainder of the order consisting of condensing and feed-heating plant will be manufactured in Australia to English Electric designs. The turbo-alternators will be installed at a new power station at Vales Point, situated 70 miles north of Sydney on the southern shore of Lake Macquarie. The station, when complete, will be the largest in the southern hemisphere with a capacity of 1,500-MW. It was also The English Electric Company which was awarded a contract in 1956 to supply Australia's first 100-MW turbo-alternator sets for the New South Wales Electricity Supply Commission's Tallawarra Station, where the first unit is now being installed. Won in open competition with other large turbine builders, the new order will now mean that the English Electric Company has in hand seven 200-MW units and two 275-MW units. The sets are similar to the first 200-MW unit now being installed at High Marnham for the Central Electricity Generating Board, which will be the first 200-MW tandem reheat set to operate in the United Kingdom. The new machine will embody modern design features which have been evolved and developed in the company's extensive research laboratories. The 200-MW 3,000 r.p.m. steam turbine will be of the three-cylinder design, arranged in line and having a double-casing impulse-type high-pressure cylinder. Steam will enter the turbine stop valve at 2,350 lb./sq. in., 1,050 deg. F. From the h.p. cylinder it will be taken to the reheater and returned to the i.p. cylinder at 455 lb./sq. in. and 1,000 deg. F. The i.p. cylinder is to be combined with one section of the three-flow low-pressure cylinder, which will exhaust to a single-shell condenser—the vacuum at the most economical and continuous maximum rating being 28.4 in. Hg. (Bar 30 in.). A six-stage feed-heating system will give a maximum temperature if 460 deg. F. at C.M.R. Feed-water deaeration will be supplied, with provision for off-load deaeration. The feed heating and condensing plants will be manufactured in Australia. The alternator will be of the hydrogen-cooled design, employing direct cooling of the stator and rotor conductors at a rated gas pressure of 30 lb./sq. in. The hydrogen coolers are to be arranged longitudinally in the upper part of the stator frame, and circulation of the hydrogen through the machine and coolers will be by means of an axial-flow blower driven from the exciter gear box. Generation will be at 16,000 volts. The exciters will comprise a main and pilot unit arranged back-to-back on the same shaft and driven through gearing from the tail end of the alternator. They will be totally-enclosed and ventilated on the closed-circuit principle, the air being circulated through the machines and coolers by means of a direct-coupled fan.

THE ELECTRICITY COUNCIL, UNIVERSITY SCHOLARSHIP SCHEME

The first boys ever to be awarded scholarships by the Electricity Supply Industry, while still at school, will be going up to university this autumn. They are the successful candidates in a scheme introduced by the industry in England and Wales last autumn to help meet its growing need for highly-trained scientists and engineers. Under the scheme, sixth formers intending to read for degrees in science and engineering were invited to apply for scholarships worth £450 a year at Oxford and Cambridge and £400 a year at other universities. The only "strings" attached to the award are that scholars will be expected to spend a period of training with the industry before going up to the university—possibly as little as six weeks—and return to it for at least two years after taking their degree. Particulars of the awards were sent to public and grammar schools throughout Great Britain and about 350 applications were received. Following interviews, 45 scholarships were awarded, 19 of them by the Central Electricity Generating Board, which requires both scientists and engineers, and 26 by the 12 Area Electricity Boards, which require electrical engineers only. We understand that the scheme will be continued during the coming academic year, and head masters will be receiving particulars in September. The courses which the successful candidates will take up, include natural sciences, chemistry, physics, mathematics, electrical engineering, mechanical engineering and civil engineering.

We very much regret that, as a result of the recent dispute in the printing industry, and which extended over a period of approximately seven weeks, publication of this issue of "Engineering and Boiler House Review" has been seriously delayed. Although the circumstances were entirely beyond our control, we nevertheless offer readers and advertisers alike, our apologies for any inconvenience the late appearance of this issue may have occasioned them. Our printing department is now working normally and futhermore is making every effort to enable production of subsequent issues to adhere to normal publication schedule as early as possible.

Coal—Its Rank and Properties

By J. P. LAUDER, B.Sc.(Tech.), M.Inst.F. *

THE centres of industry in this country have grown up around the coalfields, which can be designated roughly as follows:—(a) *South Wales*—centred on Swansea; (b) *Midlands*, including Birmingham and the Potteries; (c) The *Yorkshire* coalfields served the mills in the eastern Midlands (though now much of the coal is exported south and west); (d) *Lancashire*, based on Manchester, and the industrial zone associated with it; (e) on the *North East* coast there are the heavy engineering industries, based on the Durham coalfields. Finally, the *Scottish* mines serve the heavy industrial belt between the valleys of the Clyde and the Forth. There are, of course, a few smaller and less important sources, for example, in Somerset, Kent and Cumberland; these produce only a fraction of the fuel mined in the main zones.

It is interesting to note how the behaviour of coal during the process of combustion is affected by three features:—the percentages of moisture, the ash and the caking properties. With reference to surface moisture, as distinct from moisture present in the inherent form, it is obvious that large coal can hold comparatively little. A doubles sizing, for example, will retain, under normal circumstances, barely 3 per cent. of free water, whereas smalls can retain up to 30 per cent. by weight. Whilst the latter figure is obviously far too high, some water is very useful, in that it tends to improve combustion conditions, especially with a chain-grate stoker, the probable optimum value being about 10 per cent. This amount will ensure that the fuel burns evenly, and, by limiting the formation of holes in the firebed, helps to maintain a higher overall CO_2. That is to say, it enables the fuel to be burnt with a less amount of excess air than would otherwise be the case. It is true, of course, that the more water present in the fuel, the more heat is required to evaporate it before combustion proper can commence. Thus, some of the energy in the coal has to be used to heat the water, and change it into steam, and then to superheat it to the temperature of the gases. Heat energy expended in this way is obviously wasteful. Moreover, 10 per cent. of water in the fuel means that one-tenth of every pound is inert instead of being combustible. These losses only become really important when the moisture exceeds this figure of 10 per cent. Up to that point it is correct to say that whilst the coal may be lower in calorific value on account of the water it contains, the actual efficiency of the plant may be higher, and better steaming may follow, due to the improved combustion conditions which will result through the presence of water.

The N.C.B. rank number gives no information regarding the ash or its properties. These properties can be extremely important, more especially when burning fuel at high rates of combustion, which is the modern practice. Some forms of ash are classed as refractory, others easily fusible. The refractory types of ash are those which begin to soften in a reducing atmosphere above a temperature of 1,200 deg. C. The others soften below this temperature. A coal with only a small percentage of ash may not be difficult to burn, even if the initial softening point is below the critical figure; there is not sufficient material to fill the air-spaces in the grate formation of the automatic stoker. On the other hand, a coal of low ash content (for example, with a content of only 3 or 4 per cent.) may increase operating costs for quite another reason. There is so little incombustible present, that no protective layer is formed on the grate surface, and overheating of fire bars or links in a chain-grate stoker can therefore occur. The safe limit for a machine of this type is about 8 per cent. ash, and fuels

N.C.B. CLASSIFICATIONS

Code No.	Type of Coal	Use	Volatile matter (per cent.)
100	Anthracite	Non-caking	9.5 or less
100a	Anthracite	Non-caking	4.0 to 6.5
100b	Anthracite	Non-caking	6.6 to 9.5
200	Low volatile steam coals		9.6 to 20.0
201	Dry steam coals	Non-caking	9.6 to 14.0
	Sometimes divided into:		
201a			9.6 to 12.0
201b			12.1 to 14.0
202	Coking steam coal	Weakly caking	14.1 to 15.5
203	Coking steam coal	Medium caking	15.6 to 17.5
204	Coking steam coal	Strongly caking	17.6 to 20.0
206	Heat altered low volatile coal	Non-caking or weakly caking	9.6 to 15.5 15.6 to 20.0
	Medium-volatile coals:—		
300	Heat altered—medium volatile	Usually non-caking or weakly caking	20.1 to 30.0
300a		Medium caking	
300b		Non-caking or weakly caking	
301	Coking coal	Usually very strongly caking	20.1 to 30.0
	High-volatile coals:—		
400		Very strongly caking coal	over 30.0
401			30.1 to 37.0
	For Durham this type has been divided into:		
401a			30.1 to 33.0
401b			33.1 to 37.0
402			over 37.0
500	Strongly caking coal		over 30.0
501	Strongly caking coal		30.1 to 37.0
	For Durham this type had been divided into:		
501a			30.1 to 33.0
501b			33.1 to 37.0
502			over 37.0
600	Medium caking coal		over 30.0
601	Medium caking coal		30.1 to 37.0
602	Medium caking coal		over 37.0
700	Weakly caking coal		over 30.0
701	Weakly caking coal		30.1 to 37.0
702	Weakly caking coal		over 37.0
800	Very weakly caking coal		over 30.0
801	Very weakly caking coal		30.1 to 37.0
802	Very weakly caking coal		over 37.0
900	Non-caking coal		over 30.0
901	Non-caking coal		30.1 to 37.0
902	Non-caking coal		over 37.0

* Director and Manager, Technical Dept., James Hodgkinson (Salford) Ltd.

containing less than that should be burnt with caution. The Low Ram coking stoker is not quite so fastidious.

Coal is broadly classified as groups numbered 100 to 900, according to the percentage of volatile present, and the caking properties. Generally, the higher the group number, the higher the volatile content, and the lower the rank, the lower the calorific value. High-rank coals, therefore, have low numbers, while low rank coals carry high numbers.

Each group is sub-divided again; thus, for example, in group 200 there are fuels containing:—

9.6 to 12.0 per cent. volatiles, classed as 201A
12.1 to 14.0 ,, ,, ,, ,, 201B
14.1 to 15.5 ,, ,, ,, ,, 202
15.6 to 17.5 ,, ,, ,, ,, 203
17.6 to 20.0 ,, ,, ,, ,, 204

In this list alone, the actual behaviour of the coal during combustion can vary enormously. Other groups are treated in a similar way, the higher number signifying the higher volatile percentages. For instance, a coal classed as 901 would contain slightly less volatile matter than one rated at 902.

Thus the high-rank coals are those with the highest percentages of carbon. The anthracites, with volatiles of only 7 or 8 per cent., are rated at rank 100, they have non-caking properties, and are extremely expensive. They are not normally used for steam raising purposes. The main source of anthracite is, of course, the belt running west to east in the South Wales division, north of Swansea. There is a small yield from Kent right on the coast, and very limited amounts are mined in North Scotland and in Ireland.

Considering now the other end of the scale, the low-rank coals are rich in volatiles. These fuels are rated at 800 and 900, and have very weakly caking properties. Thus at both ends of the scale, there are non-caking, or weakly caking coals.

The 800 and 900 rank coals are obtained mainly from the Midlands and Scotland, although they are also found in Warwickshire, Leicestershire, Nottingham and South Staffordshire. There are also deposits in Yorkshire, Lancashire, and at the north end of the Northumberland coalfields. In Scotland they are produced around the areas of Ayrshire, Fifeshire, and the Lothians.

TYPES OF BRITISH COALS

Rank	Type and percentage of total output	Main classes of use	Source of supply
100	Anthracite: (1½ per cent.)	Malting; steam raising domestic heating	South Wales; small amount from Scotland.
201	Dry Steam Coals (2½ per cent.) ...	Steam raising; domestic heating	South Wales.
202-4	Coking Steam Coals (4½ per cent.) ...	Steam raising esp. locomotives; carbonisation ...	South Wales; small amount from Kent.
206	Heat-altered coals: (a) low volatile (½ per cent.) ...	Steam raising; domestic heating	Scotland and Durham.
300	(b) Medium Volatile (½ per cent.)	Steam raising ...	Scotland; very small amount South Wales and Durham.
301	Medium volatile special caking coals (6½ per cent.)	Carbonisation ...	South Wales, West Durham and Kent, very small amounts from Somerset.
400	High volatile very strongly caking coals (6 per cent.)	Carbonisation ...	Durham, South Wales, Yorks, small amount Northumberland, Lancs, Somerset, North Staffs.
500	High volatile strongly caking coals (20 per cent.)	Carbonisation; house	Yorks, Durham, Northumberland, Notts, North Derby, Lancs, Cumberland, South Wales, North Staffs, small amount North Wales, Scotland and other coalfields.
600	High volatile medium caking coals (13½ per cent.)	Carbonisation; steam raising and "Producers"; house	Yorks, Notts, North Derby, Lancs, Scotland, Northumberland, North Staffs, Durham, North Wales, small amounts from other coalfields.
700	High volatile weakly caking coals (16½ per cent.)	Locomotives; steam raising and "producers"; house	Yorks, Notts, North Derby, Northumberland, Scotland, Lancs, and North Staffs, small amounts other coalfields.
800/900	High volatile very weakly or non-caking coals (28 per cent.) ...	Steam raising; house	Notts, North Derby, Scotland, Warwicks, Yorks, Cannock Chase, Leics, Lancs, South Derby, North Staffs, Northumberland, South Staffs, Salop.

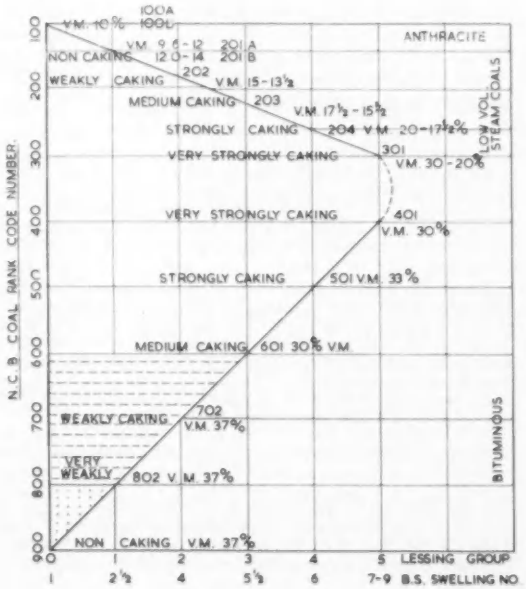


Fig. 1. Graph showing relation between N.C.B. coal code numbers and caking properties.

Between these extremes of coal ranks, if consideration is first given to the high-ranking coals, that is to say, those with low numbers, the caking properties rise to a peak as shown on the graph (Fig. 1), at rank 301, and thereafter decrease again as the 900 region is approached. Take, for example, rank 301, which is one of the most strongly caking. This is a true coking fuel and is ideal for the production of metallurgical furnace coke. North of Cardiff it is mined in a wide arc, and this, together with that produced in West Durham, provides the main source of this most important raw material. It is true there is a small supply available in the northernmost part of the Kent coalfield, and in addition, there are one or two local deposits in Scotland. There are no deposits of this type of coal available anywhere in the Midlands areas.

It has been explained where three of the main classes of coal occur in the British Isles. On either side of rank 301, there are 203 and 400. These are both fairly strongly

caking, useful for the gas-producing industry, but can be considered rather difficult to burn for steam-raising purposes. They may, however, be handled effectively at modest rates of combustion, depending, of course, upon sizing. One would expect these fuels to be associated geographically with the very strongly caking 301 group. The 203, for example, lies close to it in South Wales, as well as in Kent. The 400 occurs in scattered areas in Somerset, adjacent to the 301 group in Durham, and in three smaller zones, North Staffordshire, Lancashire in the vicinity of Wigan and Burnley, and throughout a seam in the Barnsley area of Yorkshire.

APPROXIMATE OUTPUTS OF VARIOUS RANKS OF COAL
Thousands of Tons

Division	100	200	300	301	400	500	600	700	800	900	All Coal Rank Codes
Scottish	209	538	636	138	49	768	2,221	4,325	8,520	5,584	22,988
Northern (N. & C.) ...	—	—	—	8	612	4,613	2,303	5,853	2,272	30	15,691
Durham	121	144	766	6,821	7,051	12,951	1,296	163	—	13	29,326
North Eastern	—	—	—	—	2,047	17,239	12,350	12,282	5,917	263	50,098
North Western	—	—	—	94	472	3,594	6,376	4,062	3,169	169	17,936
East Midlands	—	—	—	—	376	2,060	6,960	9,092	16,084	13,888	43,460
West Midlands	—	—	—	—	267	1,317	1,453	2,519	10,505	2,202	18,263
South Western	3,641	14,657	203	7,599	1,509	2,476	452	406	—	—	30,943
South Eastern	—	702	—	1,159	—	157	—	—	—	—	2,018
Great Britain	3,971	16,041	1,605	15,819	12,373	45,175	33,411	38,702	46,467	22,149	235,723

Table showing approximate outputs of various ranks of coal in thousands of tons.

All the remaining ranks are very suitable for burning on Low-Ram and chain-grate stokers. These are the 201B, occurring widespread in South Wales, with a small field in Kent, the 500, 600, 700, 800 and 900 varieties, which form the bulk of coal production in this country. Just west of Sunderland, in County Durham, and north east of Glasgow, there are two deposits of " heat altered " fuel, which are not very important, but are none the less interesting. The coals themselves are ranked from 100 to 300. They tend to have lesser caking properties than one would normally associate with them, due to the fact that they are rather lower in volatile matter than their group number would lead one to expect. This change has been caused probably through some form of volcanic action in the past.

Consideration of the types of machines available in this country for burning coals mined in this country shows that if the Sprinkler is disregarded, since it cannot be said to comply with the Clean Air Act, there remain only the Low Ram, the Chain-Grate and the Underfeed.

(a) The *Low Ram stoker* is designed to burn coals of mixed sizing, for example, 1½ in. slack. It will also handle graded coals or washed smalls. So far as ranks are concerned, the recommendations are, 700, 800, 900, 600 and 201B, in that order of preference. Ranks 500, 400, 300 are acceptable at lower ratings.

(b) On the *chain-grate stoker*, coal sized above 1 in. should be avoided. Its best performance is given with ½-in. washed smalls having a moisture content of about 10 per cent. and ash not less than 8 per cent. It will burn satisfactorily coals ranked at 700, 800, 900, 600 and 201B, in that order of preference, but it should perhaps be mentioned that the 800 and 900 ranks, which are virtually non-caking, could very well give rise to excessive grit emission and rather frequent flue cleaning. Ranks 500, 400 and 300 can also be burned, but at reduced outputs.

(c) The *underfeed stokers* operate best with graded coals, which should be low in caking properties. Probably the best fuel would be the 700 singles, although 800 and 900 graded varieties can also be burned satisfactorily. In the South Wales area, rank 201B is convenient. Washed smalls, ½-in. or 1-in., of these groups are also acceptable.

Clearly, then, practically all the bituminous coals mined in the British Isles are suitable for mechanical firing, except the very small percentages which are classed as extremely strongly caking, and should be reserved purely for the production of furnace coke. These special coking fuels only form about 12 per cent. of the total output of both deep-mined and opencast coals. For all the rest, there is an efficient mechanical stoker.

COLLEGE OF TECHNOLOGISTS

The establishment of The College of Technologists was announced recently by the governing body of the National Council for Technological Awards, the chairman of which is Lord Hives. The college will administer the award of Membership of The College of Technologists (M.C.T.), which the National Council propose to create as a qualification higher than the Diploma in Technology. The College of Technologists will operate within the framework of the National Council for Technological Awards and will be served by the same administrative staff. A board of scientific and industrial studies is to be responsible for the academic and industrial aspects of the administration of the award. The governing body of the National Council has met as the Court of the College, and the following appointments to the board have been made:—*Sir Arnold Hall*, M.A., Hon.A.C.G.I., F.R.Ae.S., F.R.S., Managing Director, Bristol Siddeley Engines Limited (Chairman); *Mr. A. W. J. Chisholm*, B.Sc. (Eng.), A.M.I.Mech.E., A.M.I.Prod.E., A.R.T.C.S., Head of Department of Mechanical Engineering, Royal Technical College, Salford; *Dr. H. O. J. Collier*, B.A., Ph.D., Director of Pharmacological Research, Parke Davis & Co. Ltd.; *Dr. J. W. Cook*, Ph.D., D.Sc., Hon. Sc.D., F.R.I.C., F.R.S., Vice-Chancellor, Exeter University; *Professor P. V. Danckwerts*, G.C., M.B.E., M.A., S.M., Professor of Chemical Engineering Science, Imperial College, London, and Shell Professor-elect of Chemical Engineering, Cambridge. *Professor E. Giffen*, D.Sc., Ph.D., M.I.Mech.E., Professor of Civil & Mechanical Engineering, Queen Mary College, London.

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A central information department of **Associated Electrical Industries Limited** is being established in London under the joint management of **Mr. H. H. Lusty** and **Mr. R. H. Veysey,** who will be concerned respectively with advertising, and press and public relations. Mr. Veysey is now assistant (public relations) to Lord Chandos, chairman of A.E.I., and Mr. Lusty is now publicity manager of Metropolitan-Vickers, one of the principal companies of A.E.I.

* * *

Elliott Brothers (London) Limited (a subsidiary of Elliott-Automation) announce that **Mr. L. Bagrit** has been appointed chairman and chief executive, **Dr. L. L. Ross** managing director, **Mr. E. O. Herzfeld** deputy managing director and controller, and **Mr. G. C. Fairbanks** and **Cmdr. H. Pasley-Tyler,** R.N. (Retd.), assistant managing directors. **Mr. L. C. Upsdell** is now a director and secretary of the company.

New Nitrogen Factory for Fisons Limited

A NEW ammonium nitrate factory, built for Fisons Limited at Stanford-le-Hope, Essex, was opened on June 9th, by Lord Netherthorpe, President, the National Farmers' Union of England and Wales. The decision to manufacture ammonium nitrate was based on a requirement for nitrogen in a form more concentrated than had been available to Fisons for the manufacture of granular compound fertilisers. Prior to the opening of the new factory the material used as a nitrogen source was ammonium sulphate (21 per cent. N). Replacement of ammonium sulphate by ammonium nitrate (35 per cent. N) permits manufacture of more concentrated compound fertilisers containing the three essential plant food elements—nitrogen, phosphorous and potassium. The new factory has a capacity of 400 tons/day of ammonium nitrate.

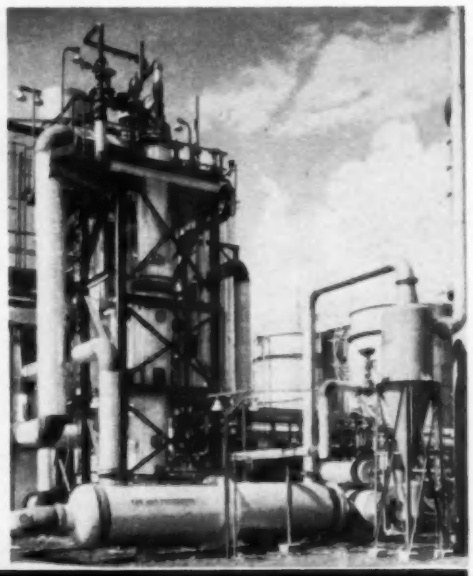
At Stanford-le-Hope the total area of the site on which the new factory has been constructed is 63-acres. Of this, the area approved for development was 42-acres, and that actually occupied by the plant which forms the subject of these notes, 25-acres. Construction started during April 1959 and the plant was first put into operation during March, 1959. Brian Colquhoun and Partners acted as civil engineering consultants and Sir Lindsay Parkinson & Co. Ltd. carried out the civil engineering work. Ammonia nitrate is manufactured from ammonia in a two-stage process. Part of the ammonia is oxidised to nitric acid, which is then neutralised with the remaining ammonia to produce ammonium nitrate. In this instance both the nitric acid plant and the ammonium nitrate plant were supplied by The Chemical and Industrial International of Nassau, Bahamas, while the installation of these units was carried out by Constructors John Brown acting as their associates.

The main raw material—ammonia—is purchased from the Shell Chemical Company, and pumped from their Shell Haven establishment to a 2,000-ton capacity insulated spherical tank, where it is stored at a pressure of 55 lb./sq. in., and a temperature of 5 deg. C.—conditions which are maintained by a refrigeration unit. Some 30 per cent. of the factory nitric acid requirement is also received from Shell Haven, and is pumped to a stainless-steel storage tank with a capacity of 100,000 gal. The remaining 70 per cent. nitric acid is produced on site by the Du Pont process, the capacity of the plant installed for this purpose being 223-tons/day. The spherical storage tank for which a notch ductile steel was used has a diameter of 60-ft., and was constructed by Whessoe Limited, Darlington, who were also responsible for the 100,000 gal. capacity nitric acid storage tank and two stainless-steel tanks with a combined storage capacity of 1½-million gal. for the final product (ammonium nitrate). The larger of these latter tanks, with a capacity of 1-million gal., is 80-ft. dia. and 32-ft. high. The ammonium nitrate in the tanks is maintained at a temperature of 120 deg. C. by means of external heaters through which the solution is circulated. In addition, Whessoe Limited built a number of ammonium nitrate storage tanks at various Fisons' compound factories throughout the country; these are also of stainless-steel, and are 30-ft. dia., with capacities of 150,000 gal. Three further tanks, at the Stanford-le-Hope factory, each of 40,000 gal. capacity for the storage of nitric acid produced on site were constructed by A. J. Riley & Sons Ltd.

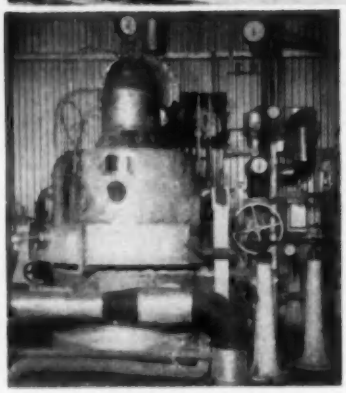
Nitric acid plant

In the nitric acid plant ammonia is catalytically oxidised by passing a 10 per cent. ammonia/air mixture through platinum-rhodium gauze pads. The necessary air is filtered and compressed to 120 lb./sq. in. in a 7,000 h.p. nine-stage rotary compressor, supplied by Brown-Boveri Limited, and driven by a steam turbine and gas turbine on a common shaft. The gas turbine, which was also supplied by Brown-Boveri, operates on heated tail gas at 80 lb./sq. in. and provides about two-thirds of the energy for the compressor, the steam turbine supplying the remainder. The steam turbine, with its associated surface condenser, was supplied by Belliss & Morcom Limited. Evaporated ammonia at 115 lb./sq. in. is fed into the air stream through a mixer and thence to the converter where the catalytic oxidation occurs. The reaction is exothermic and the catalyst is maintained at a

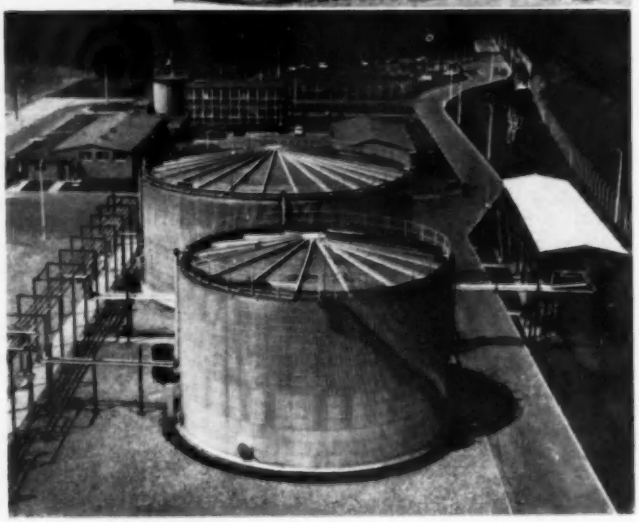
(Left). The 2,000-ton capacity spherical tank in which the main raw material of the process—ammonia—is stored. Ammonia is purchased from the Shell Chemical Company, and pumped to the site from their Shell Haven establishment.



(Right). Eastern end of the compressor house, showing waste-heat boilers, tail-gas preheater and other equipment. The nitric acid storage tanks can be seen in the background.



(Left). The nitric acid plant converter. Here ammonia is passed through platinum-rhodium gauze pads and converted to oxides of nitrogen.



(Right). These two stainless-steel tanks for ammonia nitrate storage were built by Whessoe Ltd. The larger tank is 80-ft. dia., 32-ft. high, and has a storage capacity of 1 million gallons.

temperature of about 940 deg. C. The hot gases containing oxides of nitrogen are first cooled in a series of heat-exchangers and then in a waste-heat boiler. Final cooling is achieved in a serpentine cooler sprayed with water. The cold gases are mixed with secondary air and passed into a bubble-cap absorption tower, where the oxides of nitrogen are absorbed in water to form nitric acid. The product flows continuously to storage. The gases leaving the tower contain traces of oxides of nitrogen and to meet the alkali inspector's requirements must be reduced in concentration. Fuel gas is injected at this point, and the mixture is passed through a catalytic fume eliminator which converts oxides of nitrogen to innocuous nitrogen. Heat produced in this reaction is recovered as steam in a second waste-heat boiler. The purified tail gases, at a pressure of 80 lb./sq. in., pass through the gas turbine which forms part of the air compressor unit, and thence to atmosphere via a stack. More than sufficient power to operate the plant is recovered by the gas turbine and as steam. Steam surplus to the requirements of the steam turbine is passed out to the factory.

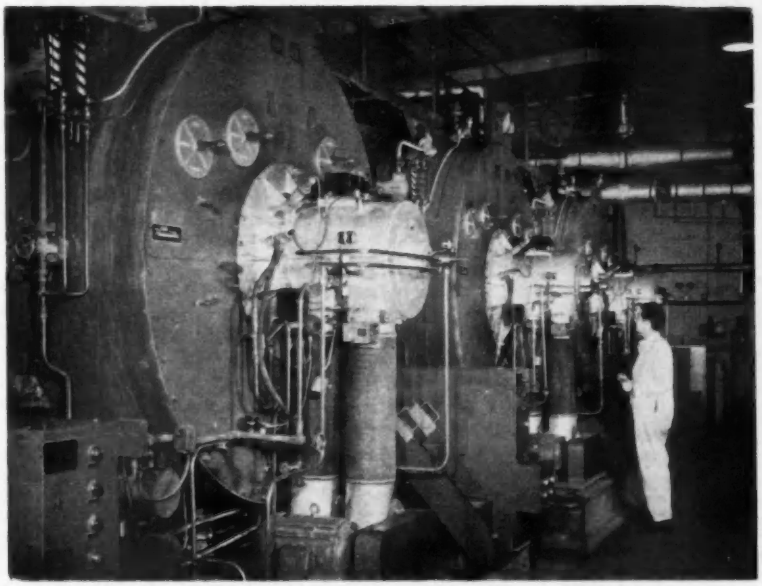
Ammonium nitrate plant

The Stengel process, in which nitric acid and ammonia are mixed in a specially designed reactor, is used to produce the factory's final product. The reactor is essentially a stainless steel tube packed with stainless steel rings, with a mixing device in the top section. Nitric acid is pumped through a heater into the mixer of the reactor, where it meets a stream of ammonia vapour. The mixture passes down through the reactor, and sufficient heat is developed to boil off most of the water present in the nitric acid. Ammonium nitrate solution and steam from the base of the reactor flow through a separator, from which the ammonium nitrate

product is pumped to storage through heated stainless steel pipelines.

Both the nitric acid and the ammonium nitrate plants are fully-instrumented, the necessary instruments and control panels being supplied by Foxboro-Yoxall Limited.

Newalls Insulation Co. Ltd. carried out for Constructors John Brown Limited, the insulation of vessels and piping in the nitrogen solution and ammonia oxidation plants and the heat-exchangers, pumps and piping on the off-site facilities. "Newtherm" calcium silicate insulation, effective up to 1,400 deg. F., was used throughout as the primary material, finished with corrugated or flat aluminium sheeting. Pipe work bends were finished with emulsified asphalt and on flanges and valves aluminium



(Left). Three of the four "Powermaster" oil-fired packaged boilers supplied by GWB Furnaces Limited. Each has a capacity of 17,250 lb./hr. when operating at 250 lb./sq. in. and burning heavy fuel-oil of 3,500 sec. viscosity.

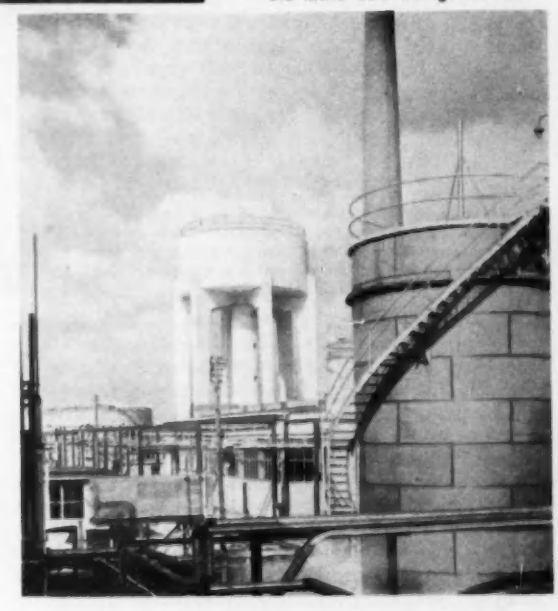
boxes lined with "Newtherm" calcium silicate slabs were fitted. William Kenyon & Sons Ltd., Dukinfield, were also responsible for certain insulation work.

Pumps manufactured by Hayward Tyler Limited were supplied for two duties, one being nitric acid transfer and the other ammonium nitrate circulation and transfer. In all cases stainless steel components were employed. The problems associated with the nitric acid pumps were orthodox ones and Hayward Tyler chemical pumps were used. These pumps were fitted with single mechanical seals, any leakage which occurred from these seals being captured in the built-in catch basin which in return is piped away to a common collecting point.

The ammonium nitrate pumps, however, presented more of a problem, in that the temperature of the liquid had to be maintained at approximately 120 deg. F. in order to prevent crystallisation, at all points in the system as well as every cavity in the pumps. The company's process pumps were used for this application as they are adequately provided with water jacket space. Normally these jackets are used for water cooling when very hot liquids are handled but in this case the jackets were used in conjunction with a steam supply to maintain the requisite elevated temperature of all internal pump surfaces. In addition serious problems existed with regard to shaft sealing. Previous operational experience elsewhere with this liquid showed that, apart from glandless pumps, no really satisfactory solution was available. It was decided, therefore, that the stuffing boxes of some pumps should be fitted with the best packing available whilst others would be fitted with double mechanical seals. This would enable the engineers to determine the most suitable method to be finally adopted. Hayward Tyler pumps are also used for ammonium nitrate handling, i.e., transfer and circulation, at the other Fison depots which receive the hot liquid from the Stanford-le-Hope plant.

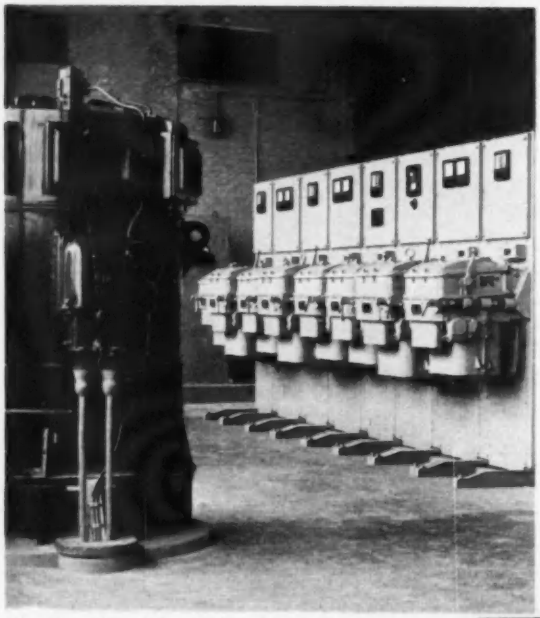
Boiler plant

The boiler plant installed at the new factory comprises

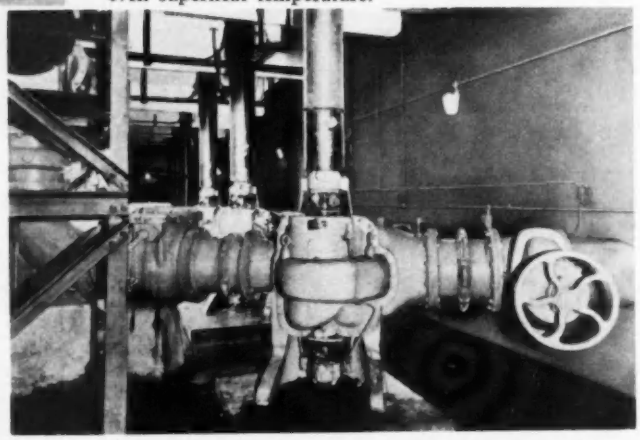


(Below). View showing the 150,000 gal. high-level concrete tank in which town water for process use is stored. The 150-ft. boiler chimney can also be seen, and in the foreground is part of one of the nitric acid storage tanks.

four, model-500, "Powermaster" packaged oil-fired units supplied by G.W.B. Furnaces Limited, each designed for a maximum output of 17,250 lb./hr., at a pressure of 250 lb./sq. in. The fuel burned in these boilers is heavy fuel-oil of 3,500 secs. Redwood No. 1 viscosity, and the oil-burning equipment, also supplied by G.W.B. Furnaces Limited, is of the "Voriflow" medium-pressure, air-atomising-type. All the boilers were fire-tested in the manufacturers' works before despatch, and were supplied complete with all ancillary equipment, ready for connection to the supply services. They are completely smoke-free in operation, and are fully-modulating, with a turn-down ratio of 5 : 1. Correct fuel/air ratios for optimum firing are maintained over the modulating range, and output basically adjusts itself to the factory steam demand.



(Above). One of the N.S. variable-speed a.c. motors manufactured by Laurence, Scott and Electromotors Limited, for driving the pumps supplying water for works process cooling, and the cooling tower. Switchgear associated with these can be seen in the background.



(Right). View in the water pumphouse basement, showing some of the pumps supplied by Worthington-Simpson Limited. These are all of vertical split-casing ball bearing, centrifugal design. Each pump is connected to its motor by a Hardy-Spicer cardan shaft, with spline and universal couplings.

The single brick chimney provided to serve all the boilers was constructed by Danks of Netherton Limited, Building Department, and is 150-ft. high, with a refractory lining for the first 30-ft. The inside diameter of the lined portion of the chimney is 6-ft. 6-in.

Stillite Products Limited supplied the necessary materials and carried out the insulation work associated with the boiler plant. All steam, condensate, feedwater and oil-fuel pipework was insulated with "Stilag" mineral wool pipe sections, finished in hard-setting composition, while the flue-gas ducting was insulated with "Stillite SR10" semi-rigid slabs, covered with metal cleading.

For normal factory operation, the demand can be met by one boiler only, supplemented by by-product steam from the nitric acid plant. The remaining boilers are required for starting-up the nitric acid plant following a shut-down, and for this purpose, the steam supply to the turbine of the acid plant compressor is passed through a separate, oil-fired superheater in which the steam temperature is increased to 540 deg. F.

The superheater was supplied by Urquhart's (1926) Limited, and comprises a compact, all-welded coil arrangement with self-draining headers; an oil-fired, high intensity combustion chamber with a high velocity discharge; and a control pack to provide the combustion chamber with oil and air at the right conditions to meet steam superheat demands. These components were all designed by Urquhart's and built into a single construction capable of being transported as a unit, but also easily replaced as complete items for maintenance purposes. The fuel burned in the superheater is 3,500 secs. Redwood No. 1 oil and the plant is arranged for remote start from a control panel, and modulation of the oil input in accordance with rapidly varying steam inputs to maintain an even superheat temperature.

Particular attention has been paid to the life and fouling of the superheater tubes by study of the aerodynamic design of the gas flow around the coil and the stability of the flow by special combustion chamber conditions. This has led to a design involving a low emissivity, high velocity exhaust jet from a high intensity combustion chamber resulting in almost complete combustion of heavy oils. This combustion chamber provides a gas velocity suitable for entrainment of the necessary high-temperature re-cycle products to bring the gas temperature down to an acceptable heat transfer gradient, but at the same time allows the maximum mass flow on the lower temperature surfaces, by the induction of large volumes

of re-cycle gas from the second gas pass. Such a design is dependent upon the momentum of the jet exhaust gases, the jet diameter, the entrainment section length and diameter and the resistance to the flow of the re-cycle gases. In this case, the aerodynamic design was considerably influenced by the practical shape of the coil arrangement consistent with expansion, tube bending, weld preparation and structural support. Finally a design was evolved using parallel gas flow and mixed steam flow. The minimum amount of refractory material was used in order to ensure the maximum rate of response of the combustion chamber to superheat demands and to provide the minimum thermal lag in case of rapid steam fluctuations.

The standard controls provided with the boilers are augmented by further instruments supplied and installed by Electroflo Meters Co. Ltd. A single instrument cubicle carries instruments for the four boilers and the superheater. Meters are provided to measure steam flows to the factory and to the separately-fired-superheater, and also to measure the steam-header pressure. Temperatures of steam, feedwater and flue gases are measured, together with CO_2 content in the flue gases. All instruments are of the recording type, providing permanent data for assessing plant performance.

An additional feature of the installation is the inclusion of draught stabilising controls. A hydraulically-operated regulator having self-contained oil-reservoir and pumping unit is connected to a multi-leaf damper in the common flue and maintains a suction of 0.35-in. w.g. in the common flue at boiler outlets. The measuring element of the regulator is of the forced-balanced type and operates over a total range of 0.5-in. w.g. This control maintains a constant pressure drop across all the boilers, thus stabilising combustion conditions.

Water supply and treatment

Feedwater for the full range of boilers consists of 90 per cent. condensate returns, the remaining 10 per cent. "make-up" being drawn from the South East Essex main supply by way of a 90-ft. high raw water storage tank, constructed by Tileman & Co. Ltd.

Plant supplied by Permutit Limited has been installed to treat the make-up water only, and handles a flow of 2,500 gal./hr. Since the boilers operate at a comparatively low pressure silica removal is not essential and the object of the feedwater treatment is reduction of scale forming hardness compounds with maintenance of an above neutral pH. This has satisfactorily been achieved by the installation of a hydrogen-ion starvation/base-exchange softening system; the effluent having a total dissolved solids content of only 240 p.p.m., whilst pH is maintained at 8.4. Treatment comprises four stages, the first being the reduction of temporary hardness solids by the hydrogen-ion "starvation" process. Raw water is drawn from a storage tank and passes through a vessel containing "Zeo-Karb" 216. This weekly-basic hydrogen-ion-exchange resin effects removal of the bi-carbonates and releases CO_2 in the process. The second stage involves CO_2 removal in a de-gasser. After bi-carbonate "starvation" the semi-softened water is forced down through a tower against a continuous upcurrent of air. The continuous air stream "picks up" the free CO_2 in the water and vents it to the atmosphere from the top of the tower. In the third stage, the de-gassed water is collected in a sump at the base of the de-gassing tower and is dosed with a small amount of caustic soda to neutralise any remaining CO_2 and to effect pH correction. Finally, the semi-treated water is passed through a vessel containing "Zeo-Karb" 225—a sodium-ion-exchange resin; this effects removal of permanent hardness calcium and magnesium salts. After softening the treated water is pumped to a 10,000 gal. capacity storage tank. Regeneration of the hydrogen-ion "starvation" unit and the base-exchange softening unit involves flushing the former with diluted sulphuric acid and the latter with brine. Chemicals for regenerating purposes and for pH correction are held in bulk storage tanks, from which they are drawn for dilution in mixing tanks. The plant is manually-operated but ancillary equipment is automatic. The treated water storage tank permits a continuous softened water "draw off" for boiler feeding while the flow through the treatment plant is temporarily halted for purposes of regeneration; this occurs once every 24 hours.

The boiler feed pump provided is of G. & J. Weir Limited manufacture, and is a Weir Electrofeeder, size E.F.4, six-stage unit, capable of delivering 36,000 lb./hr. at 160 deg. F., with suction at atmospheric pressure, plus 4-ft. positive head against a discharge pressure of 260 lb./sq. in., when direct-driven by a 25-h.p. electric motor running at approximately 2,900 r.p.m. The pump is fitted with a Weir non-return discharge valve.

Water for cooling purposes is drawn from the Thames, and supplied via a 24-in. dia. main from Shell Haven. Incoming water is first dosed with aluminium sulphate to flocculate suspended matter, then allowed to settle in a conical concrete sedimentation tank, from the bottom of which sludge is withdrawn from time to time. The clarified water flows to a concrete inflow pond. From this pond, cold water is circulated to the process plants by two variable-speed 6,000 gal./min. capacity centrifugal pumps. Return water from the process plant flows via a flume to an adjacent cooling tower pond from which the warm water is pumped over the cooling tower by two further variable-speed 6,000 gal./min. capacity centrifugal pumps. Both the cold water and warm water circulating systems are provided with a standby pump. The pumps for the works process cooling-water supply and for the actual cooling-tower were manufactured by Worthington-Simpson Limited. The former are type-16NLA3 and the latter type 16NLA1, both being of the vertical split-casing ball bearing, centrifugal design, of zinc-free bronze construction. Each pump is connected to its motor by a Hardy-Spicer cardan shaft (approximately 8-ft. long, face to face) with spline and universal couplings. Suitable motor stools were also supplied, while other fittings included gland-sealing lubricators, cooling water pipes for bearings and grease lubricators. The motors for driving these pumps are N-S variable-speed a.c. units supplied by Laurence, Scott & Electromotors Limited. For the works supply pumps the motors are rated at 315/155 h.p., running at 1,050/800 r.p.m., and for the cooling tower pumps, 130/60 h.p., running at 1,100/800 r.p.m. The motors are controlled by the "Asrec" speed control system, and a system of auto-paralleling control which brings into operation an additional pump when required by the demand, provision being made for adjusting automatically

(*Continued on page* 223)

New Cochran Vertical Boiler

COCHRAN is almost a household word in the industrial steam-raising industry throughout the world, and attached to the name is a reputation earned by the essential features incorporated in, and the continued success achieved by, the famous vertical boiler of that name during the past 80 years. It was in 1878 that Cochran & Company started general engineering and shipbuilding work in Duke Street at the north end of Birkenhead, with Edward Crompton, the inventor of the boiler, and James Taylor Cochran as partners. The immediate success of the boiler was so great that, in 1881, no fewer than four eminent firms were manufacturing the unit under licence. The chief activity of the firm in the early days was the building of steam launches, tugs and yachts, complete with propelling engines and boilers, whether of the Scotch Marine or Cochran type.

Having connections with the shipping industry, and confident of the suitability of the Cochran design for its use as a donkey boiler, there soon developed satisfactory trade which involved repeated additions to the company's premises and plant. It became more and more difficult to meet the increasing demand from a larger range of customers, without space to expand the works on the restricted site. The directors decided, therefore, to seek a new location where there would be room to extend the company's manufacturing activities. They settled on a site in Dumfriesshire, on the banks of the River Annan, close to the ancient border town bearing that name. In the early years, shipbuilding proceeded alongside boilermaking; some 20 vessels being launched and completed, more than half of them being destined for overseas.

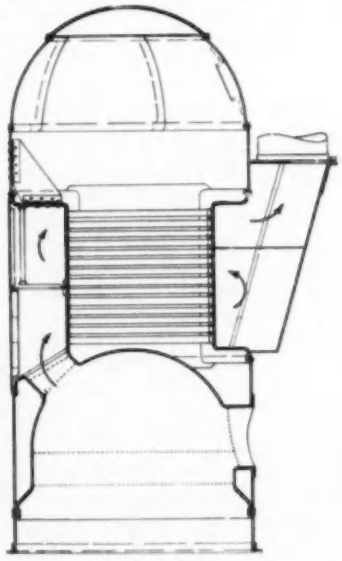
In 1901 the shipyard was closed, and energies were concentrated on the manufacture of Cochran boilers, although a few of other interesting types were made. It was in 1899, that the first Annan-built Cochran boiler was completed, thus these boilers have now been made at the Annan works for 60 years. The main novelty in the original Cochran boiler was the introduction of horizontal fire-tubes into a vertical cylindrical shell by means of flanged tube plates. Over the years the boiler, has, of course, been greatly improved in detail design—the unit combining the advantages of the vertical boiler—small floor space and no need for brickwork setting, with the economy of horizontal, multitubular design.

From time to time the company has carried out new and important developments. Soon after the technique of steam storage was adopted in this country, the firm made in 1928, a Ruths steam storage accumulator, and has made them ever since—the largest such vessel manufactured being 75-ft. 0-in. long by 11-ft. 3-in. diam., weight 105 tons, and designed for a working pressure of 250 lb./sq. in. In 1944, a controlling interest was secured in the Ruths business, which has been fully incorporated into the Cochran organisation as a subsidiary under the name of Ruths Accumulators (Cochran) Limited.

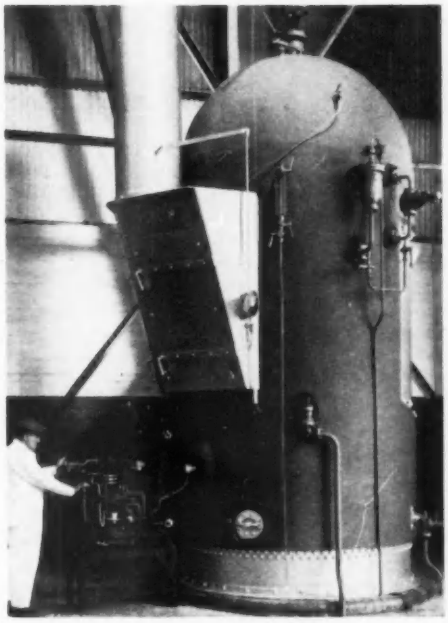
The exceptional advantages of the Sinuflo tube were recognised in 1934 when an agreement with the patentee enabled the firm to manufacture horizontal shell-type, waste-heat boilers. The Sinuflo tube was embodied also in Economic type and (both vertical and horizontal) gas-fired boilers which were added to the Cochran range of products. Incorporated in the designs were other special features that have maintained the reputation of the company as being in the forefront of development of highly efficient steam-raising units.

The new Series II vertical boiler

The new range of Cochran vertical, multi-pass oil-fired boilers covers steam outputs initially from 1,750 to 8,300 lb./hr. from and at 212 deg. F. Known as the Series II, the new boiler embodies improved heat transfer surfaces which enable a full load efficiency of over 80 per cent. on the gross calorific value of the fuel to be guaranteed under practical operating conditions. Many new features have been incorporated in the design of the new boiler, which is based on that of the well-known Cochran vertical unit, to achieve a greater heat transfer than has hitherto been obtained. This has been made possible by dividing the smoke-tube bank into three passes of small diameter tubes giving a long gas travel at high velocity. The new tube arrangement also increases the surface area, thus giving optimum heat transfer. Also, to increase the radiation transfer, the furnace has been enlarged. Another new feature is the fitting to the boiler of a specially-tuned, pressurised jet burner made by the Brockhouse Heater Co. Ltd. An important advantage of the boiler is that it can be readily converted to coal-firing, a feature by no means common with a number of types of boiler now available. This can be accomplished by removing the division plates between the



Sectional side view of the new Cochran Series II vertical boiler for outputs from 1,750 to 8,300 lb./hr.



New Cochran vertical multi-pass high-efficiency oil-fired boiler.

gas passes, thus converting the boiler to single-pass operation when it can, if need be, work under natural draught conditions. Hitherto, vertical boilers have been regarded as economical, compact units to be installed in situations where a horizontal boiler may be inconvenient or extravagant. Now, the Cochran Series II is claimed to be equally as efficient as the horizontal boiler, with the additional advantage of saving floor space, and economy of cost. For example, the floor space required for the new Cochran boiler is about half that needed for a horizontal boiler of the same output. Furthermore, the Cochran boiler requires little additional ceiling height over its horizontal equivalent. We understand that it is the company's intention to extend the range of evaporative capacities in due course. Details of the present range of Series II units are given in the following table.

PRESENT RANGE OF COCHRAN SERIES II BOILER

Evaporation lb./hr. from and at 212 deg. F.	Boiler Diam.	Boiler height	Approx. weight (empty). (cwt.)	Approx. water capacity at working level (cwt.)
1,750	4 ft. 9 in.	11 ft. 3 in.	112	35
1,950	5 ft. 0 in.	12 ft. 0 in.	125	42
2,200	5 ft. 3 in.	12 ft. 6 in.	144	46
2,700	5 ft. 6 in.	13 ft. 0 in.	158	52
3,300	6 ft. 0 in.	14 ft. 0 in.	196	65
4,150	6 ft. 6 in.	14 ft. 6 in.	225	80
4,950	7 ft. 0 in.	15 ft. 6 in.	265	100
6,100	7 ft. 6 in.	16 ft. 9 in.	315	125
7,200	8 ft. 0 in.	17 ft. 0 in.	365	150
8,300	8 ft. 6 in.	18 ft. 0 in.	430	165

NEW FOUNDRY AMENITIES AND EQUIPMENT

A few weeks ago, officials of the Amalgamated Union of Foundry Workers and the National Union of General & Municipal Workers were invited to inspect new foundry amenities and equipment recently installed at the Newark works of Worthington-Simpson Limited. The foundry amenities comprise showers, wash basins, lead-light mirrors, footbaths, and provision for dirty and clean clothes which are safeguarded by padlocks with individual keys. The installation has cost £10,000 and was designed in consultation with representatives of the 180 foundry workers for whom it caters. The rooms are tiled throughout to facilitate hygiene in general and easy washing down in particular. Water is supplied at a controlled temperature of 110 deg. F., and no effort has been spared to ensure that these new amenities offer a complete service for the foundry workers. Staggered hours permit easier use of the amenities, and a pilot scheme was operated for a few weeks to iron out possible difficulties. These welfare improvements come side by side with the new foundry scheme which obliterates dust and fumes, thus providing a much cleaner working atmosphere. Equipment for the scheme, comprises—new sand-mills and sand storage-hoppers, with conveyor distribution to the mechanised section; fume exhaustion after pouring into moulds on a mechanised moving track to a vibrating knockout grid with exhaust arrangements for fumes and dust. In addition, there is a mechanised moving belt to the sand slinger for the heavy floor moulding section with a static knock-out with exhaust fumes and dust equipment. It is hoped that the clean, dust-free, and fume-free atmosphere resulting from these new installations will provide more congenial conditions for the workers.

An unusual transport problem

The longest unit ever produced by the boiler division of Ruston & Hornsby Limited was recently despatched. The unit, a 90-ft. long by 5-ft. dia. column, built to the order of Foster Wheeler Limited, is for the new Esso Milford Haven petroleum refinery. Rustons' boiler division specialises in the manufacture of such vessels for the petro-chemical industries as well as in the production of steam-raising plant.

Our illustration shows part of the column's journey through Lincoln from the works of Ruston & Hornsby Ltd. This clearly indicates the size of the column, and emphasises the careful planning of routes and the timing that is necessary to successfully accomplish a transport undertaking of this magnitude.

Oil Facilities at Thames Haven

RECENTLY, we were invited to visit Thames Haven to see the new developments, including new jetties, greatly increased oil storage capacity, and new pumping and pipeline equipment, all of which has been provided by London and Thames Haven Oil Wharves Limited. The present company was formed in 1898, the facilities consisting of one discharging jetty and 15 storage tanks having a total capacity of 8,000 tons. From time to time extensions were completed, and new pump houses provided so that by 1914, there were three jetties, and a tank storage capacity of 300,000 tons. By 1939, total capacity had reached a figure of about 660,000 tons and there were five deep-water jetties. However, it is during the years since the second world war that the greatest expansion has taken place. It was in 1948, after the disbandment of the Petroleum Board, that the company entered into an agreement with the Shell Refining Company for the storage of crude oil and finished products from the adjoining Shell Haven refinery.

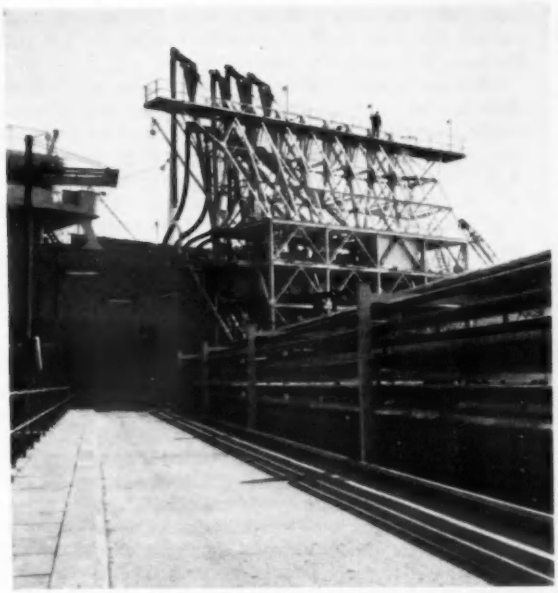
Expansion programme

This marked the commencement of a remarkable expansion programme as part of a concerted Western European plan to import and refine crude oil, rather than rely upon the importation of refined products. At that time, the Thames Haven installation covered an area of 300 acres, and occupied a water-front of $1\frac{3}{4}$ miles. It comprised 200 main storage tanks ranging from 200 to 9,000 tons capacity—a total storage accommodation of 880,000 tons. The throughput then was slightly more than 1,000,000 tons of refined products per year. During 1950 the first of a number of new petroleum refineries in the United Kingdom came into operation. As a result, 1951 saw a substantial increase in the rate of throughput at Thames Haven, nearly 4,000,000 tons of oil being imported and 2,400,000 tons of refined products delivered out. This volume has continued to increase, and in 1958 the corresponding figures stood at 6,000,000 tons, and 4,200,000 tons, respectively. To meet the steady rise in demands, jetties, storage tanks, pipe-lines and handling equipment have been modernised and extended. Storage capacity has been doubled to nearly 300 main tanks, each of up to 17,000 tons capacity, and providing a total tankage capacity of 1,750,000 tons. Still more are at present under construction. The developed area of Thames Haven now covers more than 400 acres, while there are a further 150 acres for future developments. At the present time Thames Haven has seven deep-water jetties and six coaster and barge berths. Two of the jetties (Nos. 9 and 10) were completed during the past six months; they have a dredged depth of 42-ft. below M.L.W.S.T., and a head 345-ft. long, while the respective approaches are 474-ft. and 774-ft. respectively. They have been equipped with the latest discharging facilities, including electrically-operated boom structures, high-capacity hose-handling equipment and pipelines handling up to 3,500 tons/hr. This enables tankers to be loaded or discharged within 24 hours at speeds nearly five times as fast as those of 1948, regardless of the state of tides. Last year, 455 ocean-going tankers were discharged compared with 195 in 1949, and during this period the size of such vessels rose from the 16,000 tons deadweight of the general purpose ship, to ships of 47,000 tons deadweight (nearly 60,000 tons loaded displacement).

The reinforced concrete decks of the new jetties are supported on a system of vertical and inclined steel box-piles, with the upper deck 7-ft. above normal high-water level. The steel piles were treated against corrosion by bitumen enamel and cathodic protection. The structure has been designed to absorb 25 per cent. of the kinetic energy of a 45,000 tons deadweight tanker approaching at normal berthing speed of 1-ft. per sec. The larger tonnages being handled in association with the time factor has meant increased pumping speeds, of the order of the above mentioned 3,500 tons/hr. involving large diameter pipelines and improved ship-to-shore connections. The pipelines have been brought together in the form of headers, one for white oil products and the other for black oils. Each header is rigidly and permanently connected to an electrically-operated Woodfield boom structure, which enables a connection to be made to the ship at any state of the tide with the minimum of manual aid. There are five black oil and three white oil booms, and these are linked with the appropriate headers, which are, in turn, connected to the various internal pipelines. The hose-handling equipment at No. 10 jetty is shown in the accompanying illustration, Fig. 1. An elevated pipeline has been erected along the length of the $1\frac{3}{4}$-mile waterfront, linking together all the jetties. Nearly 10 miles of pipeline varying from 6-in. to 24-in. bore, with an additional 9 miles of inland lines have been installed to complete a pipeline network of some 150 miles throughout the installation. Approximately 3,000 valves of various sizes are fitted in the piping system. Aluminium-sheathed pipelines are "steam traced" and lagged in order to maintain the requisite delivery temperatures of the heavier grades of oil heated to increase pumping speeds. The steam is fed in at strategic points, and the lagging of the pipe lines is, in some cases, carried as far as the tank. In handling the oil products, there are a number of pump-houses, which are interconnected to provide a flexible distribution system; the latest to be constructed, the west-end pump house, is shown in Fig. 2.

New pump house

This latest pump house has a sub-surface pump room to ensure "suction head" (or "flooded suction") to the pumps. The pumping units comprise three two-stage centrifugal pumps supplied by Hayward Tyler & Co. Ltd., Luton, and of 500 tons/hr. capacity. Three more of these pumps can be accommodated to



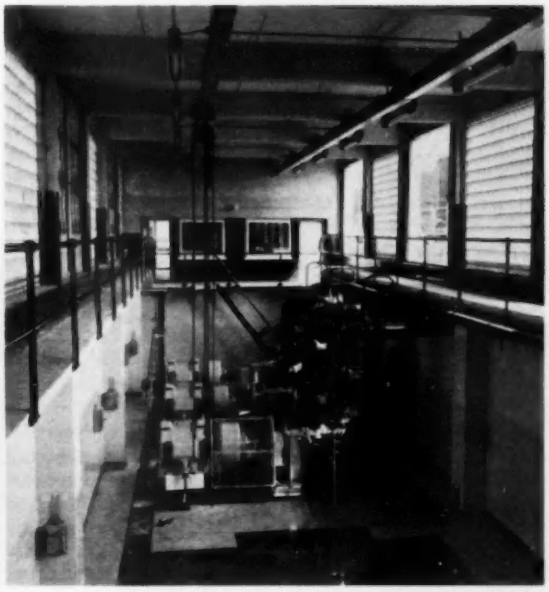


Fig. 1. (Above). The new electrically-operated high capacity hose handling equipment at No. 10 jetty.

Fig. 2. (Above, right). Interior of new west end pump house showing the three Hayward Tyler pumps driven through fluid couplings.

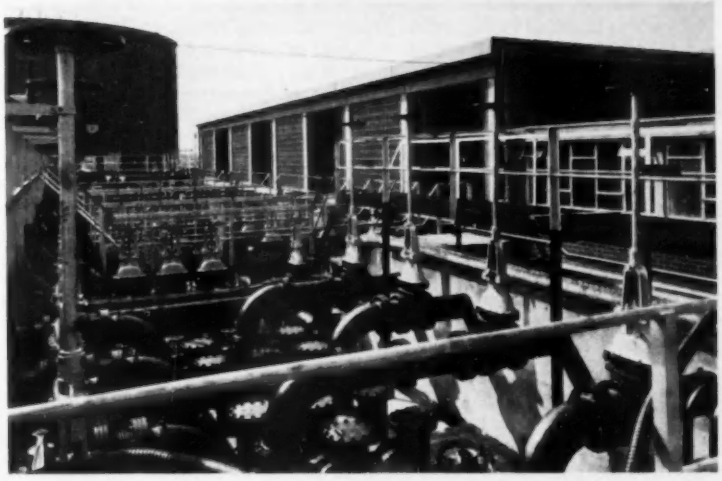


Fig. 3. (Right). Manifold pits housing pipe line headers and control valves at new pump house.

give a total output of up to 3,000 tons/hr. The pumps are driven by 250 b.h.p. motors through fluid couplings made and supplied by Fluidrive Engineering Co. Ltd. These fluid couplings are Size No. 23, Type SCR 5. At present manually-operated control is provided for, but it is anticipated that this will shortly be replaced by remote control. A sound-proof control room houses the remote starting equipment, and in the manifold pit the arrangements permit of the complete segregation of the various oil products.

The pipeline system connected to this pump house at present, services 19 tanks with a total capacity of about 120,000 tons. Existing road tanker loading stands can load up to 72 cars simultaneously. These stands operate mainly on the gravity feed system, although pressure loading is also available, and handle about 4,200 tons of fuel per day. Construction is being completed of a new fully automatic central road tanker loading stand, equipped with the latest devices. It has eight stands and will permit 16 vehicles to load simultaneously. Three grades of oil will be dealt with, any grade being available at each loading point. Two of the grades will be heated, the temperature being thermostatically-controlled at 140 deg. F. in the main tank. A series of 16-in. steam-traced supply pipe lines have been installed to ensure that the required temperature is maintained at the delivery point.

Main boiler house

To meet the demands of the complete Thames Haven installation, the main boiler house is designed to produce 75,000 lb./hr. of steam, at a pressure of 160 lb./sq. in. and at a temperature of 500 deg. F. Fitted with superheaters and supplied with economisers, the boilers are also equipped with pressure-jet fuel oil burners. Comprehensive instrumentation has also been provided to

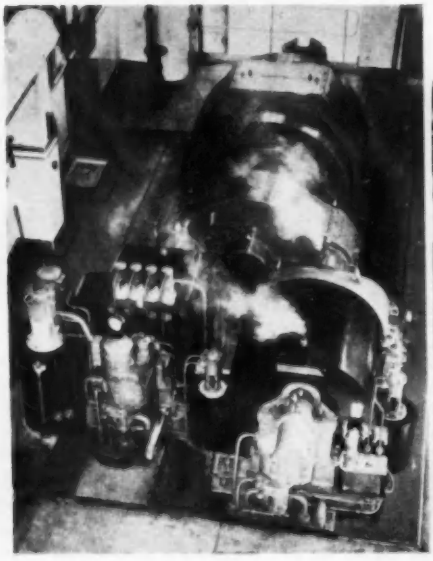
assist in maintaining an efficiency of approx. 73 per cent.—a high figure for this type of boiler installation.

The boiler plant comprises four Lancashire-type units supplied by Edwin Danks & Co. (Oldbury) Ltd., and two similar units by John Thompson (Wolverhampton) Ltd. For the four first-named units, the superheaters were supplied by The Unit Pipe & Superheater Co. Ltd. and by Sugden & Company, while for the other two boilers, Thompson superheaters are provided. All the economisers were supplied by Senior Economisers Limited, the fuel-oil burning equipment by The Wallsend Slipway & Engineering Co. Ltd., and the feed-pumps by G. J. Weir Limited. The main items of instrument equipment were supplied by Electroflo Meters Co. Ltd., and there are steam pressure and flow recorders by George Kent Limited, and smoke density recorders by Radiovisor Parent Co. Ltd.

All water is chemically treated to prevent scale formation in the boilers. Three standby boiler plants are maintained in operating condition, so that a total of some 170,000 lb./hr. of steam can be supplied to the installation. The total distribution network of piping for steam is over 22 miles long, most of the steam being used for heating the heavier grades of oil in the storage tanks to facilitate pumping. A limited number of steam-driven pumps are still in use at Thames Haven, but their replacement by electrically-driven units is planned to take place in the near future.

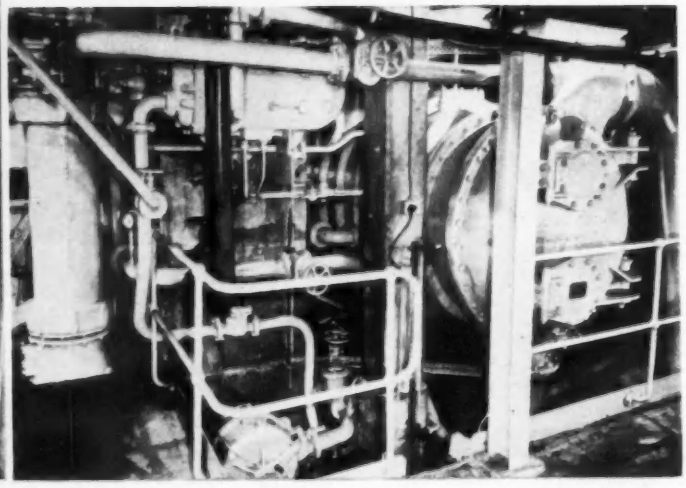
New 4,000-kW Pass-out set for Chemical Factory

A NEW 4,000-kW twin-cylinder cross-compound pass-out condensing steam turbo-alternator set manufactured by W. H. Allen & Sons Ltd. and the British Thomson Houston Co. Ltd. has recently been placed in commission at the Beeston power station of Boots Pure Drug Company's factory near Nottingham. This new set replaces a 1,000-kW back-pressure unit which was installed in September, 1929, and as the result of skilful lay-out design, the set occupies the same area of floor space as the smaller power unit. This replacement maintains the number of generating sets at Beeston at five but increases the installed capacity to 11,750-kW.



(Above). New 4,000 kW Allen pass-out condensing turbine driving a B.T.H. alternator.

(Below). Turbine house basement at Boots' Beeston Works showing condenser, oil-cooler, ejector and circulating pump. The new turbo-alternator increases the installed capacity at the works to 11,750-kW.



In addition to this, two back-pressure sets installed at the Nottingham power station of the company can each provide 1,500-kW, thus making a total installed generating capacity of 14,750-kW.

The new unit comprises a W. H. Allen high-pressure turbine running at 6,000 r.p.m., and a low-pressure turbine running at 4,000 r.p.m. Both are geared to a B.T.H. alternator which runs at 1,000 r.p.m.

Cost of the additional unit is stated to have been about £110,000 but it is estimated that the importation of extra power to meet increasing electrical load demands would also have involved a substantial capital outlay in alterations to the distribution system, including the erection of a new sub-station, the total cost of which was estimated at between £40,000 and £50,000. Moreover, the economy of space required by the new unit, which amounts to less than 1,000 sq. ft., avoided any necessary extension (approx. 2,000 sq. ft.) to the Beeston power house, which would have been required to house a more conventional direct-in-line set, and which would have added at least £20,000 to the cost of this installation.

Demand for electricity and steam has increased considerably at both the Beeston and Nottingham plants during the past 10 years. Between 1948 and 1952 the

demand for electricity rose by nearly 60 per cent., and from 1954-58 rose again by another 40 per cent.

As the firm's manufacturing operations require the use of both electricity and steam, pass-out, or back-pressure units are favoured because, by making use of the latent heat in the steam after it has passed through the high-pressure turbine, such machines are much more efficient. That this economy is considerable is illustrated by the fact that the total cost of producing electricity (including depreciation) averaged only 1.5d. per unit during the past 12 months. The thermal efficiency is between 60 and 70 per cent., which is about double that obtained in large power stations.

The steam from the pass-out and back-pressure units is used in the factory both for process work and for space-heating requirements. At Beeston, more than half of the total steam is used for process work even during winter months, but at Nottingham the ratio is about 40/60 per cent. for processing and space-heating. The major electrical load, which is distributed through nine step-down sub-stations, is largely used to drive small motors of from ½ to 5 h.p. Probably 80 per cent. of the electricity produced is consumed in this way. These sub-stations are all linked with the 11,000-volt ring main which connects the Beeston and Nottingham establishments, forming a self-contained system, including two cables each four miles long, from the main power station, at Beeston, which convey a supply to the Nottingham station, where electricity is generated purely as a by-product.

Cooling-water for Beeston, where the annual consumption is over 2,000 million gallons, is pumped from the nearby Trent Navigation Canal and returned to it at a point further downstream. The Nottingham factories on the other hand obtain nearly all their cooling-water from their own boreholes, which last year produced more than 850 million gallons. Make-up water both at Nottingham and Beeston has all to be chemically treated after being taken from the main supply.

Steam at Beeston is provided by six Babcock and Wilcox water tube boilers, four of which have individual capacities of 30,000 lb./hr. of steam (these six units are fitted with air-preheaters but have no economisers) and two 45,000 lb./hr. units (which are fitted with economisers but have no preheaters). The three Babcock & Wilcox boilers at Nottingham can each also produce up to 45,000 lb./hr. of steam, each boiler being fitted with L-type stokers supplied by International Combustion Ltd. All these Babcock & Wilcox boilers are equipped with Hagan automatic control.

Coal consumption at Beeston is approximately 47,000 tons a year, and that at Nottingham 17,000 tons a year. The entire supply is obtained from local coalfields, one of which extends to within a few hundred yards of the Beeston plant.

Compact and efficient as it is, the Boots power plant is not, of course, unique, but nevertheless compares very favourably with many operated by other large concerns.

NEW NITROGEN FACTORY

(*Continued from page* 217)

the speed of the leading pump and of the incoming pump, to meet the new pump duty ; thus ensuring the maximum possible pump efficiency under all operational conditions.

The cooling tower is a five-cell film-type induced-draught unit installed by Film Cooling Towers (1925) Ltd. Cooled water is returned to the inflow pond.

Purge water from the cooling tower system, sludge from settling tank and surface water from the site are collected in a concrete estuary pond and pumped to the river. Three pumps were supplied by Worthington-Simpson for this purpose. They are type-20/22V1 vertical split-casing ball bearing, centrifugal units, of zinc-free bronze construction, each with monel metal impeller, phosphor bronze shaft, and fescolised zinc-free bronze shaft sleeves, cast-iron base and bracket on top of the pump to carry the ball thrust bearings. Each pump is complete with cardan shaft, motor stool, etc., and fittings similar to the other Worthington-Simpson units described above. Laurence, Scott & Electromotors Limited also supplied the estuary pump motors, these being of the " Trislot " type, rated at 50-h.p. and running at 580 r.p.m. These units are switched on and off by float gear.

BOILER FOR NEW BOTTLING PLANT

A bottling plant constructed at a cost of £70,000 for Coca-Cola Southern Bottlers Limited, on the Millbrook Trading Estate, Southampton, was officially opened recently by the Mayor of Southampton. The new plant will have a total production capacity of over 100,000 bottles a day, and will serve an area within a radius of up to 60-miles, both by direct service and by trunk vehicle supplies to depots already operating at Salisbury, Christchurch, Portsmouth and Chichester. For heating the detergent tanks, and for factory space-heating, the boiler installed has an evaporative capacity of 1,700/2,000 lb./hr., and was supplied by Cochran & Co., Annan, Ltd., Scotland. It is a Size 9, vertical, multi-tubular unit, 5-ft. 3-in. diam., 13-ft. 6-in. high including the extended skirt, and is fitted with 92, 2½-in. dia. smoke-tubes, providing a heating surface of 250-sq. ft. The boiler, which is arranged for fully-automatic operation, including water-level and pressure control, is fired by 960 sec. fuel-oil through a F.A.P.-type burner unit supplied by J. Brockhouse & Co. Ltd., West Bromwich. The boiler, steam mains and condensate return mains were insulated by the Darlington Insulation Co. Ltd. The water-treatment plant supplied by Permutit Co. Ltd. has a maximum capacity of 750 gal./hr., and comprises two chemical dosing tanks and an R.M. chemical-feeder, precipitation tank, clear well, sand-filter and carbon-purifier.

ELECTRICITY COUNCIL

Lord Mills, Minister of Power, has appointed Mr. C. R. King, C.B.E., to be chairman of the Electricity Council in succession to Sir Henry Self, K.C.B., K.C.M.G., K.B.E., who retires at the end of August. Sir Henry has held the appointment since the Council was formed on January 1st, 1958, while Mr. King has been deputy-chairman of the Central Electricity Generating Board since the same date. Prof. R. S. Edwards, at present a part-time deputy chairman of the Electricity Council, is to serve full time from October 1st. Mr. King joined the Derbyshire and Nottinghamshire Electric Power Company in 1919, and from 1940-48 was general manager of that company and its associated companies ; he was a member of the British Electricity Authority, 1950-58 ; chairman East Midlands Electricity Board, 1947-57 ; and member, Central Electricity Authority, 1956-57. Mr. King has served as chairman of the Council of the British Electrical Development Association, and was president of this year's British Electrical Power Convention.

Mr. R. J. Smith, A.M.I.E.E., has been appointed to take charge of the organisation which The General Electric Co. Ltd. is setting up in Japan to supervise the building of a 150-MW nuclear power station at Tokai-Mura, 70 miles north-east of Tokyo.

Oil-Burning Equipment Research

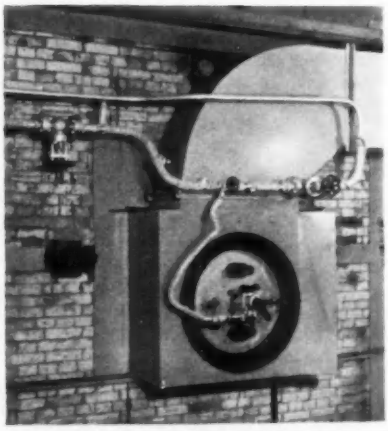
IN order to carry out further development work, and to enable them to maintain their leading position as manufacturers of oil-burning equipment, The Wallsend Slipway & Engineering Co. Ltd. has established a new Oil Burning Equipment Research Department in order to investigate firing problems arising in connection with modern demands for steam generation, and for the firing of industrial furnaces.

The Wallsend Slipway & Engineering Co. Ltd. first became interested in the manufacture and application of oil-burning equipment in 1881. In those early days, the technique of oil-burning developed largely as an art; but nevertheless highly satisfactory and efficient results were obtained to suit the requirements of the times. As the years passed, fresh fields for the application and adoption of oil-burning developed, and boiler ratings increased, thus necessitating much higher combustion rates. Consequently, the design and application of oil-burning equipment soon became more scientific and efficient. At the present time such problems obviously cover a very wide field, and therefore the new research department has been equipped with the means to carry out research relating to many different types of boilers and industrial furnaces, using various forms of oil atomisation.

Research in connection with steam generation

For steam generation in boilers of any considerable size, the pressure system of atomisation is usually adopted as being the most practical and efficient. In recent years the combustion, or heat release, rates in water-tube boilers have increased enormously, thus calling for accuracy in design, manufacture and control of the oil-burning and ancillary apparatus. For research in connection with steam generation, the department is equipped with three different types of boilers—watertube, cylindrical marine and vertical. Each one provides an opportunity to observe flame formation, as well as to obtain gas analysis and accurate measurement of fuel and water consumption, air pressures, temperatures, etc. In order to study flame formation independently of other factors, a special furnace has been provided.

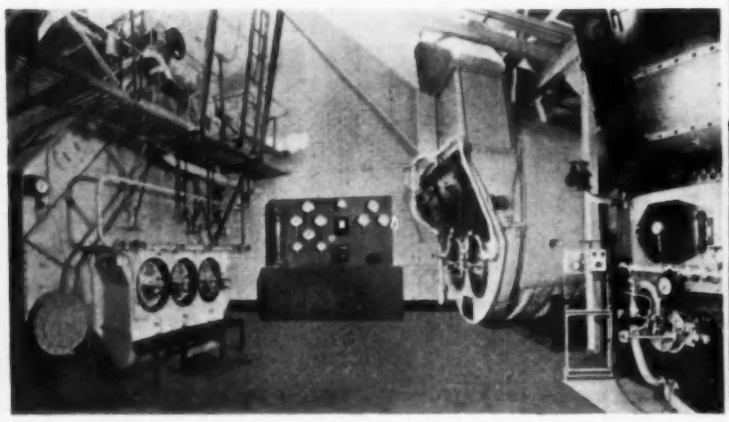
A droplet chamber, spray chamber and patternator are included in the equipment for studying and checking the efficiency of the oil-spraying burner nozzles. The efficiency of atomisation is measured by spraying melted wax from the roof of a chamber high enough for the minute wax particles to solidify before reaching the floor of the droplet chamber, from which they can be collected and gauged. The spray chamber is used for measuring the angle of spray under varying conditions. The patternator, which checks and measures the evenness of spray distribution, is a circular tank, divided radially into 24 equal parts, into which the oil is sprayed from the nozzle situated directly above the centre of the tank. The oil sprayed into each division is led to separate graduated glass tubes, so that the flow into these tubes

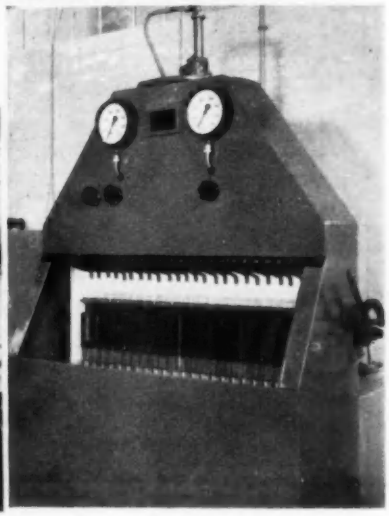


(Right). The Wallsend pistol-grip safety-type pressure burner and forced-draught air distributor fitted to a test furnace.

(Below, right). Patternator for checking and measuring the evenness of spray distribution.

(Below, left). General view of the boiler room at the new Wallsend Slipway research centre.





is a measure of the evenness of distribution of the spray. In order to cater for special requirements in large power plants and certain marine installations much development work has been done in connection with remote and automatic control of oil-burning.

Industrial types of furnaces are also included in the new research department for development and study of hand, automatic and self-proportional air/oil ratio control. In these furnaces air is generally adopted as the atomising agent varying from medium pressures of about 30 lb./sq. in. to relatively low air pressures of 30 to 25 in. w.g. The low air pressure type of burner is also used extensively in smaller boiler installations and has been developed for automatic control.

In the earliest applications of oil burning, the oil was atomised by the impingement of a steam jet on to the oil and this method is still employed in certain designs. The Wallsend Oil Burning Research Department is also equipped for comprehensive research on direct pressure, air pressure and steam-jet systems of burning oil.

Power from Underground Gasification

A 3.75-MW power station is now operating from gas produced at the underground gasification project developed by Humphreys and Glasgow Limited, for the National Coal Board at Newman Spinney, near Chesterfield. Work on this project was due to end on June 30th following a recent decision by the National Coal Board, whose opinion was, that further expenditure on it was not justified as far as the fuel needs of this country are concerned. An entirely new system is being used. A shaft was sunk to the coal seam and a gallery driven horizontally. From this gallery, boreholes were drilled within the coal seam for distances up to 450 ft. The drilling of these boreholes itself represented a considerable achievement, since the seam is only 27-in. thick, and the holes are 14-in. diam. Vertical holes were drilled from the surface to intersect the horizontal boreholes at the ends remote from the gallery. Another notable achievement was in making accurate intersection between these vertical holes and the horizontal holes 200-ft. below them. Novel techniques to achieve this included the use of a remote reading compass for surveying the horizontal boreholes, developed in association with the Admiralty Compass Observatory. Radioactive isotopes were also used to assist in making these intersections.

Other boreholes were drilled from the surface to intersect the gallery for primary admission of air to the system. Secondary air inlet boreholes were also prepared to be brought into use if required as gasification proceeds. When the system was completed, ignition was started in the gallery. This was brought about by "bonfires" of coal and timber ignited electrically from the surface. Air blown down the boreholes into the gallery brings about a gasification reaction, following which, gases travel along the boreholes within the seam and back to the surface via the vertical uptakes, and thence by means of surface mains to the power station built by the Central Electricity Generating Board. The gas is cooled by the direct injection of water, supplemented by surface cooling of the mains. These simple methods, while suitable for a pilot plant which is only due to work for a short time, would, on a commercial plant, be replaced by conventional gas-cooling equipment. Air for gasification is supplied by electrically-driven blowers which are located in a building adjacent to the power station for convenience of control, and the air is taken to the field by mains which run parallel to the returning gas-main. The gas approaching the power station can, if required, be passed through a booster. The gas produced by this means is of low calorific value, and at present is only considered as a source of power. It is burned in a boiler of special design, to raise steam which is fed to an old turbine of the Brush-Ljungström type and which had previously been installed in a small power station. A wide range of indicating and recording instrument equipment is provided for close and accurate control of every state of the process.

The economics and technical results of underground gasification are greatly improved with increasing thickness of seam. It has long been known that the seams at Newman Spinney were on the lower margin of thickness. Even with such thin seams, it would appear that gas can be produced at a cost not exceeding 3d. per therm. This cost could be greatly reduced where thicker seams are available, and there are already several possible applications overseas in countries where this condition applies. The purpose of the National Coal Board project was to produce gas from seams which would not otherwise have been mined. Meanwhile, it is claimed that certain positive advances have been obtained in the British project, notably in the technique of directed drilling, and these are likely to have valuable applications in other fields.

General view of the Newman Spinney site. The power station can be seen (right, centre). Pipes in the foreground supply air to the ignited coal underground. Gas brought to the surface is supplied to the station by the gas main running left to right.

RECENT Equipment AND Accessories

Steam control stop valve

A new control stop-valve for use in steam lines is being introduced by Sir W. H. Bailey & Co. Ltd.; known as the "Bi-Seat," it is of a unique, patented design which, it is claimed, affords an extremely high degree of control and double protection of the working parts. It is designed for controlling a flow of steam at working pressures of up to 300 lb./sq. in. and temperatures as high as 500 deg. F., particularly where frequent use is expected. On initial opening, the main valve is raised approximately $\frac{1}{16}$ in. clear of its flat seat, but the orifice remains sealed by a special spring-loaded parabolic plug. As the unit is opened more fully, the plug is gradually withdrawn from the orifice to provide a streamlined annulus for the passage of steam. This design makes it virtually impossible

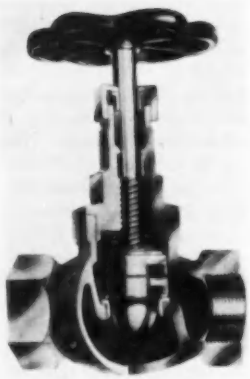


Fig. 1. The new "Bi-Seat" control stop valve. (Sir W. H. Bailey & Co. Ltd.)

for foreign matter to be trapped on the main valve seat, and the fine degree of control—from minimum flow to full bore—allows steam to be admitted slowly to a cold system with full protection for the valve and seat against the direct cutting action of the high velocity steam, thus preventing wire drawing. The same high degree of protection is afforded to the seat when the control valve is being closed, because the steam is shut-off by the parabolic plug before the main valve comes into close contact with it. All working parts are made of "K Monel" and stainless steel to ensure a long and trouble-free life. (*Sir W. H. Bailey & Co. Ltd., Albion Works, Patricroft, Manchester.*)

Silencing feature for air blowers and compressors

A completely new method of "sound-deadening" for their single and multi-stage axial-flow air-blowers and compressors used for temperature control has been evolved by Plannair Limited. In solving the noise reduction problem Plannair have concentrated on reducing the amplitude of the vibrations over the critical 900-3,000 c.p.s. range. This they have achieved by packing the space confined by the exterior surface of the circular housing and end flanges with sound absorption material held in position by an outer wrapper plate. Noise vibrations are intercepted and absorbed by specially-situated openings provided in the main blower housing. Tests on modified blowers have shown that the reduction in noise level is equivalent to approximately 15 decibels in the critical range. Where silenced blowers have been installed in equipment, satisfactory reductions in noise levels have been achieved. Important features of the new development are that there are no external additions to be fitted to the equipment—the dimensions of the silenced blower are identical to those of a comparable unsilenced model—and there is no appreciable alteration in performance. (*Plannair Limited, Windfield House, Leatherhead, Surrey.*)

Packaged cooling-tower

An interesting new development in water-cooling technique is the production of a complete "packaged" cooling-tower small enough to be transported in a light-weight lorry. It has been designed by Film Cooling Towers (1925) Limited, and has a basin, shell and splash-tray made of resin-bonded glass-fibre, a construction which, while contributing to the lightness of the unit, eliminates the necessity of protective painting. This unit has been specially developed to meet the needs of industries requiring small-scale water-cooling facilities at a moderate cost, and is available in a range of capacities from 300 to 5,000 gal./hr. The tower operates on the induced-draught principle; the fan and motor, being mounted on the canopy, expel the air from the top at high velocity. The cooling-air entering at the foot, at a relatively slow speed, is circulated evenly over the base area and throughout the interior of the tower. The packing is of the well-known Film Flow design which provides the maximum possible heat transference in a small space. It is composed of a number of horizontal trays of parallel laths, each layer being at right angles to the trays immediately above and below it. The water is discharged from spreader troughs which run along the entire length of the tower, and it flows down the grid packing, changing direction through 90° in every 2-in. down the whole depth of the tower. A continuously changing film of water meets the ascending air without obstructing its course and, as no drops are formed, the loss of water by entrainment is negligible. The internal packing which is made

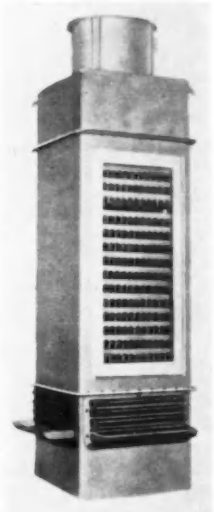


Fig. 2. A model from the new range of packaged cooling towers. These are available for capacities from 300 to 5,000 gal./hr. (Film Cooling Towers (1925) Ltd.

of impregnated timber is proof against attack by all known forms of wet, dry and soft rot organisms. The unit is supplied ready for immediate operation—merely requiring to be coupled after the ground has been suitably levelled. Since the pond basin is an integral part of the tower, no concrete or steel tank and foundations are necessary. Provision is made for anchor bolts for use when installed on a roof top or in any location where high wind forces prevail. Built-in lugs are provided for crane slings. The packaged cooling-tower requires practically no maintenance and operating costs are therefore reduced to a minimum. [*Film Cooling Towers (1925) Limited, Lionel Road, Kew Bridge, Middlesex.*]

New diaphragm improves flow metering

Honeywell Controls Limited have recently improved the accuracy of flow and liquid-level metering by installing a new high-performance diaphragm on their differential converter transmitters. The "pneumatic balance" differential converter, which previously contained a "Fluon"-coated diaphragm separating high- and low-pressure chambers, now uses "Viton" as a diaphragm coating. The new diaphragm is claimed to provide better long-term stability of measurement, and higher stability under varying temperatures. In addition, it has good chemical resistance, and can be used to meter alkalies, amines, hydrocarbons, and dilute or concentrated mineral acids. (*Honeywell Controls Limited, Ruislip Road East, Greenford, Middlesex.*)

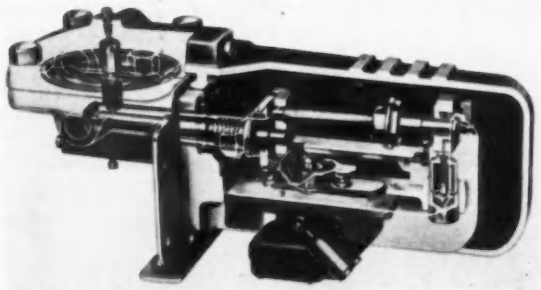


Fig. 3. The new "Viton"-covered diaphram is now incorporated in this Honeywell differential converter. (Honeywell Controls Ltd.)

Hydraulic four-way valve

Hunt & Mitton Limited announce the introduction of a new range of pneumatically-operated four-way valves for the control of double-acting hydraulic rams, eliminating the need for two three-way valves of the conventional type. These valves, which are suitable for operation either through a manual pilot or an electric timer, are operated by a single diaphragm top. This simplification is achieved by using the line pressure to operate one section of the valve on a differential area principle. A two-way valve may also be installed in one of the cylinder lines, to allow the ram to be stopped in any position desired. The valve is so-designed that there cannot be any loss of water to drain, when the disc travels from one seat to another. The seat surfaces are also protected from wire drawing by skirted seat rings. Water hammer or shock due to sudden release of pressure in the valve is eliminated by the use of V-slots in both inlet and drain seat rings of valves. Materials used in the construction of the valve are of the highest grade bronze, stainless-steel and monel, while packers are of a special composition developed for water service. The valves are suitable for hydraulic working pressures from 200 up to 3,000 lb. sq. in. (non-shock) at temperatures up to 140 deg. F., and are made in sizes of $\frac{3}{4}$-in., 1-in., $1\frac{1}{2}$-in. and 2-in. respectively. A 300-lb. rating four-way valve is also available in sizes of $\frac{3}{4}$-in. and $1\frac{1}{4}$-in. only. (*Hunt & Mitton Limited, Oozells Street North, Birmingham* 1.)

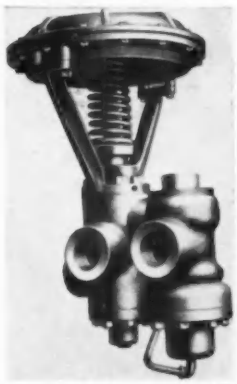


Fig. 4. A model from the range of Hunt & Mitton pneumatically operated four-way valves. (Hunt & Mitton Ltd.)

New range of pneumatic nut-setters

The Airetool Manufacturing Company have introduced a range of pneumatic nutsetters. The model 400-N non-reversible, is a straight-type with a lever throttle, and as with all models in the range, is available with an adjustable clutch, positive clutch or direct drive—and in one of four different operating speeds. The model 400-NP, non-reversible, is equipped with a pistol-type grip and trigger throttle, but can also be obtained with a thumb-rest handle. The even balance and light weight of this tool, together with its compact design and quiet running are claimed to be features that help towards increased production at reduced costs. The model 400-RN, reversible, is designed as a straight-type with a lever throttle. It can be used for either tightening or removing nuts, and the straight-type design is recommended for applications where working space is limited. Finally, the range includes the model 400-RNP, reversible—a pistol-type tool with a trigger throttle. To change the direction of the socket, the cap reverse operates easily with a flick of the thumb. (*The Airetool Manufacturing Company, 328 S. Center Street, Springfield, Ohio, U.S.A.*)

Large size variable flow indicators

Walker, Crosweller & Co. Ltd. have extended their range of Arkon variable-flow indicators. These instruments can be adjusted for high or low velocities of flow, and now include sizes $1\frac{1}{4}$-in., $1\frac{1}{2}$-in. and 2-in., in addition to $\frac{1}{2}$-in., $\frac{3}{4}$-in. and 1-in.; the principle of cartridge construction being applied in these instruments. With Arkon indicators, the complete cartridge assembly is interchangeable between the different sizes. The spindle impeller assembly, which is fitted in a cartridge housing, is easily removed and reset for the required flow range. The indicator itself is simple and reliable, and shows at a glance whether flow is taking place. A chromium-plated ring at the top of the spindle under a toughened glass dome stops spinning if the flow stops. Arkon variable-flow indicators are used to indicate the flow of water, lubricating oil, cooling oil, and other liquids. (*Walker, Crosweller & Co. Ltd., Cheltenham.*)

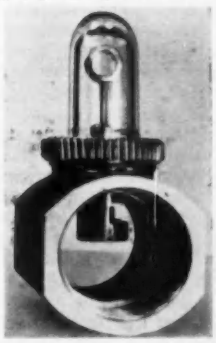


Fig. 5. The "Arkon" variable-flow indicator now available up to 2-in. size. (Walker, Crosweller & Co. Ltd.)

Lightweight angle drills

The range of lightweight drills now being produced by the Consolidated Pneumatic Tool Co. Ltd. has been extended by the introduction of two new models with angle heads of 45° and 90° respectively. The capacity is $\frac{3}{16}$-in., and each model is available in free spindle speeds of 5,000 or 3,000 r.p.m. with a built-in adjuster for speed variation. These units, belonging to the CP-3008 series, have a weight of only $1\frac{1}{2}$-lb. They are supplied with a lever-type throttle, and are fitted with adjustable exhaust deflector and suspension bail. "Power Vane" air motors are employed, and a $\frac{3}{16}$-in. collet is provided in the

standard angle models; 3/32-in., ⅛-in., and 5/32-in. collets can be supplied as optional equipment. The spindle and rotor turn on ball-bearings, whilst needle-bearings are used for mounting idler pinions. Lubrication is achieved by a built-in oiler which serves all gears and bearings. (*Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.*)

Automatic control for metering pumps

The DCL " M " range of metering pumps produced by The Distillers Co. Ltd. has now been adapted for automatic control. Developed primarily for the accurate metering of small quantities of fluids, the new range can now be operated with pH, temperature, flow and other controls. These automatically-controlled pumps are responsive to pneumatic signals of from 3 to 15 lb./sq. in., adjustment of the plunger stroke being carried out by a small, compact bellows motor operating through a mechanism designed to reduce " hunting." Available with different plunger sizes giving a range of capacities from 0-750 c.c./hr. to 0-37.3 litres/hr., the pumps are suitable for working pressures up to a maximum of 2,400 lb./sq. in.; the maximum pressure depending upon capacity. The output from each pump is proportional to the air pressure, the control gear being designed to give maximum capacity at either 3 or 15 lb./sq. in. Pump heads are interchangeable, the head in each case being easily removed and replaced by one of different capacity. Power is provided by a 1/15 h.p. totally-enclosed induction-motor. The suction and delivery valves, both of which are duplicated, are of 12 per cent. chromium non-corrodible steel balls specially lapped to ensure high volumetric efficiency. Valve bodies, seats and the valves themselves can be readily removed by merely slackening one set screw, to facilitate inspection and maintenance.

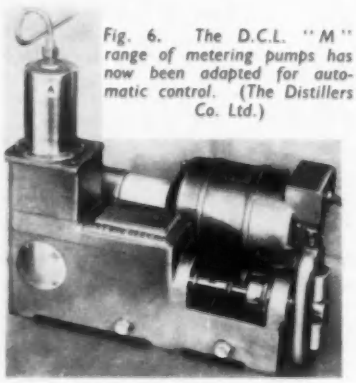


Fig. 6. The D.C.L. " M " range of metering pumps has now been adapted for automatic control. (The Distillers Co. Ltd.)

As with other types of DCL " M " pumps, hydraulically-operated diaphragm heads are available for applications where it is desirable to avoid having glands in contact with the liquid being pumped. This is especially useful in cases where noxious fluids are being handled or when sterile conditions are required. Automatically-controlled DCL " M " metering pumps are an addition to the standard ranges of DCL equipment. (*The Distillers Co. Ltd., Great Burgh, Epsom, Surrey.*)

Internal bunker vibrator

Efficient discharge from storage bunkers containing powdered, granulated, or lump materials can be facilitated by use of the new Sinex internal bunker vibrator, made by Sinex Engineering Co. Ltd. The equipment can be combined with external vibrators for dealing with very difficult materials, and among its special advantages are accessibility of the power unit, ease of replacement when necessary, and the fact that it offers no obstruction to the material in the hopper. The device consists of a rotary electric vibrator attached to a steel reed which hangs down into the bunker. The complete assembly is suspended from a rolled steel joist across the top of the bunker by means of anti-vibration mountings which isolate the hopper structure from vibratory effects. In operation the vibration passes down the reed with increasing amplitude, reaching a maximum at the lower end of the reed where the material in the hopper has a tendency to arch. As vibration loosens and releases the material, the pressure of the latter on the reed varies and causes it to bend and move about the hopper; vibration is therefore always applied at the most needed point and thus ensures complete discharge of the contents. Constructed of mild steel, the reed is made up to suit the depth of the hopper for which it is required. Its dimensions vary between 18 and 24-in. wide, ⅛ to ⅜-in. thick and up to 60-ft. in length. (*Sinex Engineering Co. Ltd., North Feltham Trading Estate, Feltham, Middlesex.*)

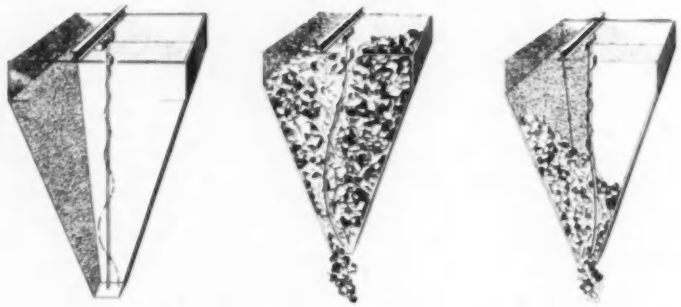


Fig. 7. Schematic arrangements showing three stages in the operation of the new Sinex internal bunker vibrator. (Sinex Engineering Co. Ltd.)

Moving coil voltage regulator

The generation of electric power is often considered in conjunction with steam raising for heating and process supplies. For example, it is often economic to produce steam at a higher pressure than required for a particular process, and then reduce the pressure through a back-pressure turbo-alternator set. As the demand for steam increases so more electrical energy may be produced, if desired, until there is a surplus which can be exported into the distribution system of the Electricity Authority. The amount of power exported may vary considerably from time to time, and, dependent upon the works

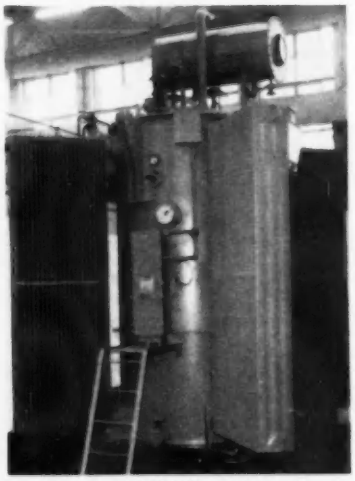


Fig. 7. A 10,000-kVA, 3-phase Ferranti moving coil voltage regulator of the type supplied recently to the United Steel Co. Ltd., Workington. (Ferranti Ltd.)

demand for steam, it may occasionally be necessary to import power from the supply authority. Local generation of electricity can also be an economical proposition where supplies of waste gas are available from blast furnaces and coke ovens. The illustration, Fig. 7, shows one of two 10,000-kVA 3-phase Ferranti moving coil voltage regulators recently supplied to the United Steel Co. Ltd., Workington, for use in such an installation. The regulators have a 14 per cent. voltage range for use in twin lines 1½-miles long interconnecting the local works system with the 11-kV public electricity supply network, and provide a method of controlling the import and export of electric power. The regulators enable the alternator voltage to be varied independently, and the current along the interconnector is maintained at an improved power factor. The improvement in power factor increases the permissible loading along the interconnector and will bring substantial financial savings. The amount of saving will, of course, be dependent upon the terms of the tariff negotiated with the supply authority. (*Ferranti Limited, Hollinwood, Manchester, Lancs.*)

Use of Iron Castings in Steam Engineering Applications

The standard practice in this country for iron castings used for steam engineering applications where dimensional stability is important, such as in steam turbine engineering, and for valves, pipe fittings etc., is to limit the temperature to below 232 deg. C. (450 deg. F.). For some time designers and engineers have considered this temperature unrealistic in view of the technological advances made in the production of iron castings. The question of raising this specified limiting temperature is important, since with more efficient steam-plant operation, higher temperatures and pressures are used, and there is a danger that iron castings may be replaced by other materials for no valid technical reason. In America, there is a standard A.S.T.M. specification for grey iron castings for pressure-containing parts for temperatures up to 343 deg. C. (650 deg. F.). This specification was prepared in conjunction with the American Society of Mechanical Engineers, and represents standard practice for boiler and pressure-vessel applications. In the United Kingdom, in a few isolated cases where foundries have been proved to have satisfactory control, the use of cast-iron for valves at temperatures up to 316 deg. C. (600 deg. F.) at pressures not greater than 300 lb./sq. in. has been sanctioned. Such castings are subject to very rigorous tests before acceptance and to pressure tests at 450 and 500 lb./sq. in. However, iron castings for some applications at temperatures above 232 deg. C. (450 deg. F.) will not at present be generally accepted. The dimensional stability of iron castings is determined by their growth and creep resistance, provided they have been given an appropriate stress-relieving heat-treatment before service. To supply the necessary data to permit the various authorities to raise the present temperature limit, an extensive programme is being carried out by the **British Cast Iron Research Association,** to evaluate the growth and creep characteristics of a very wide range of iron castings. The results of the growth tests so far carried out, have been fully reported in the B.C.I.R.A. Journal of Research and Development. Growth data are of primary importance since dimensional stability is expected to be influenced by growth rather than by the magnitude of the stresses applied. However, though stresses are generally low, creep tests are also being carried out to supplement the growth data already established, and the results of these will be reported shortly.

Newman Industries Limited, which in three years is reported to have more than doubled its sales of electric motors, is establishing two new area offices at Newcastle and Cardiff. These additional centres, together with other recent developments in the company's sales organisation, will, it is stated, increase their outside facilities in the United Kingdom by some 50 per cent.

* * *

A recent addition to the "Metalife" range of rust-proofing and corrosion resisting liquid metals for the protection of iron and steel, is "Metalife 1000." Two coats of this liquid metal, applied by brushing or spraying, will, the company claim, not only be resistant to heat (up to 1,000 deg. F.) but will give outstanding resistance to corrosion. Although this coating has only recently become freely available, it is already being used extensively on steel chimneys, boiler fronts, cupolas, ovens, etc. A leaflet available from **Southern Metalife Limited,** Station Square, Harrogate, Yorkshire, describes the full range of other of the company's products.

* * *

A recent publication (T/47) available from **Negretti & Zambra Limited,** 122, Regent Street, London, W.1, describes their new Mersteel (mercury-in-steel) rigid-stem dial thermometers. With copper stem and copper-plated steel bulb the standard range covers temperatures up to 400 deg. F., and with steel stem and steel bulb up to 1,000 deg. F.

* * *

Copies of a new film "Muscles of Control" are available on loan from the **Fisher Governor Co. Ltd.,** Airport Works, Rochester, Kent. The film is in colour, and has a running time of 25-min. The introduction summarises the dependence of today's process industries on the automatic control valve. Methods of manufacturing various valves for various functions are shown in detail. Some of the many technical difficulties in selecting the right valve for the right job—the underlying theme of the whole film—are demonstrated and explained. The advantages and disadvantages of single-port and double-port valves are discussed and the problems posed by the demand for differing types of inner-valves are analysed. Reference is also made to the effects of erosion, cavitation and vibration, and the way in which these effects are to a large extent overcome. Many types of automatic valve actuators from the pneumatic spring diaphragm valve to the very latest electro-hydraulic device, are shown and explained.

After serving for over 50 years as a director and, since 1928, a deputy chairman of W. H. Allen Sons & Co. Ltd., Bedford, **Mr. Harold Gwynne Allen,** M.A., M.Inst.C.E., M.I.Mech.E., retired from the board on June 30th, 1959. The eldest surviving son of Mr. William Henry Allen, who founded the business in 1880, he has played a dominant part in the development of this well-known engineering firm, with its world-wide organisation and business activities. Mr. Harold Allen was educated at Westminster School and Trinity College, Cambridge, subsequently obtaining his engineering training at Queens Engineering Works, and the Fairfield Shipbuilding and Engineering Co. Ltd., before being appointed to the staff of W. H. Allen Sons & Co. Ltd. As a consequence of the wide experience and knowledge he gained of the company's commercial activities, Mr. Harold Allen ultimately became responsible for the commercial side of the organisation at home and overseas.

* * *

A leaflet issued recently by **Simon-Carves Limited,** describes water-tube boilers with continuous-slagging furnaces—a development by the German firm of Vereinigte Kesselwerke AG. Boilers of this type are built in Great Britain by Simon-Carves Limited, who point out that the continuous-slagging type of furnace is also applicable to the once-through or Benson-type forced-circulation units they build in this country.

* * *

James Gordon & Co. Ltd. have recently published two new leaflets. The first (No. 103) gives a complete list of the company's equipment, the range of which has been now considerably increased since the Power Plant Division of Elliott Brothers (London) Limited, became part of their organisation. The second leaflet (No. 180) deals with the Elliott CO_2 instrument now offered as an alternative to the Mono recorder, according to the type of instrument required; the Elliott CO_2 instrument being of the thermal conductivity type whilst the Mono CO_2 recorder operates on the chemical absorption principle.

* * *

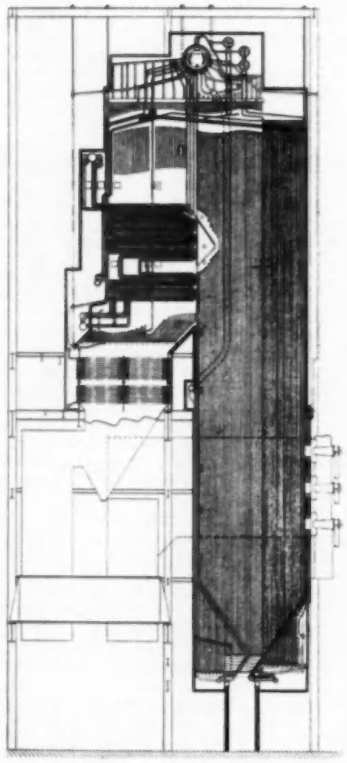
W. C. Holmes & Co. Ltd., P.O. Box No. B.7, Turnbridge, Huddersfield, have issued a new publication (No. 77) describing the range of Holmes-Kemp dryers, which have been re-designed to give higher efficiencies at lower costs. The dryers are of the totally-enclosed solid desiccant type, and they provide continuous moisture extraction from air or other gases.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Twin-furnace reheat-type steam generator

The plant installed at the River Rouge station of The Detroit Edison Co. of America now includes a new No. 3 unit, comprising a Foster Wheeler Corporation boiler which supplies steam to a 321.5-MW turbo-alternator set manufactured by the Allis-Chalmers Mfg. Co. The new unit was placed into service during October, 1958, raising the total capacity of the station to 840-MW. The boiler, which is fired with pulverised-coal, is of the twin-furnace, natural-circulation, reheat-type, designed for a m.c.r. of 2-million lb./hr. at a pressure of 2,725 lb./sq. in. The final steam temperature leaving the superheater furnace is controlled at 1,050 deg. F. from 1,335,000 lb./hr. to 2,000,000 lb./hr., at an outlet pressure of 2,450 lb./sq. in. Maximum design reheat flow is 1,800,000 lb./hr. at an outlet pressure of 475 lb./sq. in. and 1,000 deg. F. temperature, controlled over a primary steam flow range of 1,335,000 to 2,000,000 lb./hr. Each side of the unit has an identical furnace, radiant superheater and boiler section. The convection pass of one unit contains the convection reheater, and the other the convection superheater, each followed by an economiser and set of air heaters. Steam generated in furnace waterwalls and enclosure walls of the convection section is collected in the steam drum. From there it passes to the inlet of the radiant superheater through Foster Wheeler control condensers which operate to maintain steam temperature at the radiant superheater outlet or convection superheater outlet headers, depending on load. The radiant superheater forms the roof, front wall and partial side walls of each furnace. After passing through the control condensers, the steam flows down through one set of tubes and, from the bottom of the furnace, returns up in an alternate set of tubes to a superheater transfer and mixing header. The transfer header transports the steam, partially superheated, to the superheater intermediate header of the convection superheater section of the unit. The convection superheater consists of nine triple loop-in-loop sections. The steam enters the superheater at the lower or cooler end and flows upward counterflow to the gas to the superheater outlet header. After leaving the convection superheater, the gases flow through a Foster Wheeler extended surface economiser containing an effective heating surface of 63,360 sq. ft. The reheat half of the unit resembles the superheat half with the exception that the convection superheater space is now occupied by the convection reheater. This is composed of six loops of five loop-in-loop sections with the steam entering at the bottom and leaving at the same elevation as the superheater outlet header. Steam flow is again counterflow to gas. The gases leaving both economisers enter hot end regenerative air heaters, precipitators, induced draught fans, and cold end regenerative air heaters in series arrangement. The cold end air heaters reduce the gas temperature to the stack to 20 deg. F. average. The unit is fired through a total of 32 Foster Wheeler intervane burners. Twenty-four of these are 27-in. standard intervane burners for firing pulverised coal, arranged four wide and three high on each unit. Air is supplied to these burners through a common windbox. Below the pulverised coal burners, and in line vertically on each unit half, are four modified burners for the purpose of firing available blast furnace gas, piped in directly from a nearby steel mill. The gas will be fired only in combination with the pulverised coal. Steam from both radiant superheaters enters the convection superheater inlet header at approximately equal temperatures. The radiant superheater outlet steam temperature characteristic shows a decrease with an increase in boiler rating, whereas convection superheater outlet temperatures increase with rating. Since the temperature at the radiant outlet is high for low ratings, the control condensers will begin their function at fairly low ratings, in order to limit radiant superheater outlet steam temperatures to a maximum of 910 deg. F. With increased rating on the unit, the convection superheater outlet steam temperature increases until it reaches 1,050 deg. F. At this point, the control condensers will receive their FST control impulse from the convection outlet header and it is anticipated that radiant outlet steam temperature at this time will be below the prescribed maximum of 910 deg. F. Since the combination of radiant and convection superheater



Cross-section of the reheat half of the new No. 3 unit recently installed at the River Rouge station of The Detroit Edison Co.

characteristics results in a relatively flat overall characteristic, it is not anticipated that high control duties will be necessary at the high unit rating. Reheat outlet temperature is controlled by varying the firing rate of the reheat furnace. It is expected that at the full load output of 2,000,000 lb./hr. the firing rate in each furnace will be approximately equal. At lower ratings, the reheater side will require a higher firing rate than the superheater side. All pressure parts are drainable. (*Heat Engineering*, Vol. 34, No. 1, pp. 2-5.)

Complete automation for power station

An electronic control system, incorporating a solid-state, general-purpose digital computer, which will make possible complete automation, is to be installed at the 225-MW Little Gypsy power station now under construction for the Louisiana Power and Light Co. of America. The computer will control start-up and shutdown of the station, with 4½-hours required for start-up. The plant will also go "off the line" immediately upon pushing the shutdown button. The start-up operation for a large generating unit must be conditionally and sequentially controlled, and it involves about 800 steps in a typical start-up or shutdown. It will be possible to instruct the computer to turn back or go ahead to any other operational step. The system will monitor a large number of selected input signals continuously, and formulate alternative routes which could not be found using only conventional mechanical timers, sequential cams, and sensing relays. There are approximately 700 points of inspection or actuation involved in the starting of a power station of this capacity. The computer will scan and verify all "on-off" points and position indicators between each of the steps involved in starting or stopping the plant. The procedures for hot or cold start-up, for complete shutdown, and for temporary shutdown and banking the boiler will be provided as automatic functions. The automatic control system will perform all operations without human intervention. Manual operation will be required only in the event of a malfunction. When the computer puts the station "on the line" it automatically reprogrammes itself and continues to operate the plant through the following major control loops:—(1) combustion control; (2) steam temperature control; (3) feedwater control; and (4) spray control (overriding steam temperature control—a safety feature). The installation includes a fuel safety and purge system. Upon any indication of an explosive mixture in the boiler, gas is shut off instantaneously and the boiler is purged with air. Necessary shutdown procedures are instigated immediately. The computer continues to scan all inputs for over or under-limit operation. If such is found and cannot be corrected by the system, visual and audible alarms and special print-out inform the operator exactly which point is involved and how far it is off limits. Every hour the computer carries out computations on component efficiencies and overall efficiency, and measures important points of the system. All data are automatically logged. This information and information relating to any point in the system can be obtained upon demand. The computer takes less than 1 sec. to do the calculations, but 5 min. to log the data because of the mechanical lag of the typewriter. (*Combustion*. Vol. 30, No. 10, p. 52.)

The annual tour for 1959 of the **Newman, Hender Mobile Exhibition** of industrial valves, commenced with a visit to Ireland during April. Early in May it left England for Portugal where the exhibition was booked for display at the British Trade Fair held in Lisbon from May 29th to June 14th. Following the close of this fair, a tour of three weeks in Switzerland was arranged. Then Bavaria was also given an opportunity of seeing the display during ten days towards the end of July. The month of August was considered as a holiday period, after which, September is to be spent with a tour through Austria. Commencing early in October, the final six weeks of the tour will cover Western Germany. Featuring Newman-Milliken lubricated parallel plug valves, Newman-McEvoy self-sealing conduit gate valves, Vee-Reg regulating stop-valves, and forged-steel valves and fittings, the revised interior display should be of great interest to the chemical and petroleum industries. In addition, a selection of "NH" general fittings, together with the new Newman-Velan valves of particular interest to the nuclear energy industry, aim to bring to the notice of all connected with the use and purchase of industrial valves, the extensive range manufactured by the Newman, Hender group of companies.

* * *

A new leaflet (publication No. 46) issued by **Keith Blackman Limited,** Mill Mead Road, London, N.17, describes their Series-TF fabric-type dust collectors. These units have been designed to handle fine, dry dusts, and are available with capacities from 2,000 to 50,000 cu. ft./min. A feature of the Series-TF is the flexibility and compactness obtained by the use of unit construction, employing a basic element of 16 filter bags with a total filtering area of 200 sq. ft., the complete range being obtained by stacking two or more basic elements together.

* * *

A useful publication (No. 2007) was issued recently by **Sturtevant Engineering Co. Ltd.,** Southern House, Cannon Street, London, E.C.4; the title of the publication is "Friction Charts for Air Flow in Straight Ducts and Pipes," and is priced at 7s. 6d. This publication, which includes a set of seven charts, has been produced after a considerable amount of investigation, for use within the Sturtevant Organisation. But it quickly became apparent that the information contained in the publication would be very useful to fan engineers, and therefore, the company decided to reproduce it for wider circulation. The editors are Messrs. R. H. Young and J. M. Gasiorek, fan engineers, and thus concerned with ventilation, air-conditioning, pneumatic conveying, etc. Much information is given concerning friction of air ducts and pipes based on the latest generally accepted hydraulic formulae and using, as standard, the standard air adopted by the British Standards Institution for fans and other similar air moving machinery.

Interior of the Newman, Hender mobile exhibition, showing part of the extensive range of industrial valves and fittings displayed.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent office, 26, Southampton Buildings, London, W.C.2. Price 3s. 0d. each, both inland and abroad.)

Dust separator device

A main object of this invention is to provide a generally improved separator in which the concentration of fine particles in the settling container is substantially reduced so as to increase the efficiency of the separator. An impingement-type separator is shown in Fig. 1. The untreated gas in which particles are suspended enters the separator at (1) and is strongly deflected by baffle plates (2), while, due to the comparatively large mass of the particles, the latter maintain their direction of movement into a settling container (3). The cleaned gas escapes through the baffle plates (2) into an outer peripheral zone (4) of the separator and is discharged upwards in the direction of the arrow. Fitted on to the settling container (3) is a liquid atomiser (5) and a fan (6) at (8) and, by means of a rotor or impeller (9) driven by an electric motor (10), is projected with an increase in pressure into a spiral housing (11) of the blower, and escapes from an outlet (12). Owing to inertia forces, suspended particles in the gas are thrown on to the wall of the housing (11) and are deflected into a settling container (14) by a separating-plate (13) projecting inside the housing. Arranged inside the settling container (14) is an electrically powered steam generator (15) which causes an agglomeration and increase in weight of the suspended particles. Electric current for the steam generator (15) is supplied to the heater element (16) by electrodes (17). Water is fed to the steam

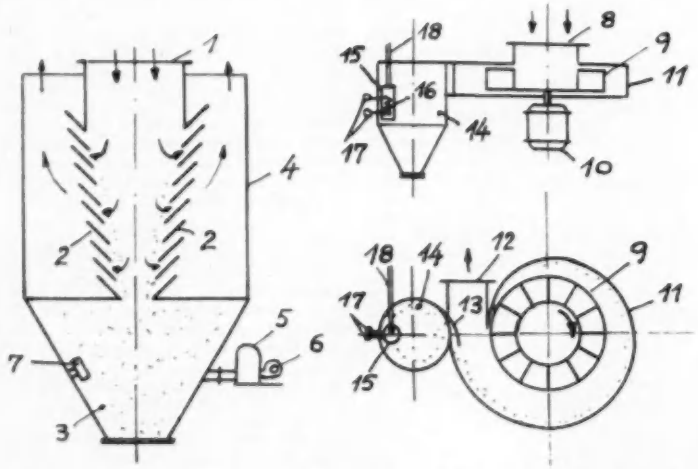


Fig. 1 (left). Fig. 2 (top, right). Fig. 3 (bottom, right). Brit. Pat. No. 812,501.

which introduces aerosol mist into the settling container. The aerosol mist causes an increase in weight and in the agglomeration of the suspended particles. An ultrasonic generator (7) can be installed in the settling container for accelerating this increase in weight and agglomeration. With a blower-type dust-extractor according to Figs. 2 and 3, untreated gas enters the separator generator (15) through a pipe line (18) and the water-level in the generator is regulated by a float-valve, not shown. The production of steam is regulated according to the supply of electric current (in kilowatts) supplied to the steam generator heater elements. *British Patent No. 812,501 issued to O. Schmid. Complete specification published April 29th, 1959.*

Steam purity measurement

This invention relates to the measurement of the purity of steam, and more specifically to the continuous purity measurement of vacuum steam, that is to say steam drawn from a system operating under sub-atmospheric pressure. The ultimate measurement will in general be made on condensed steam, for example, by means of a conductivity meter, but in any case it is necessary to draw off a quantity of steam for the purposes of the test. The testing of high-pressure steam presents no difficulty as a quantity of the steam is released from a system solely by providing the system with an outlet through which the steam is expelled under its own pressure. The expelled steam is condensed by passing it through a cooler, and the purity measurement of the condensate is then made. It will be understood, however, that when it is required to measure the purity of vacuum steam, the steam must be withdrawn from the system against the external atmospheric pressure, and this presents a difficulty not encountered in the testing of high-pressure steam. According to this invention vacuum steam is withdrawn from a system, and is condensed at a sufficiently high level in relation to a meter for measuring its purity and to the point at which the condensate is returned to the system as to maintain a flow of condensate through the purity meter. Equipment for this purpose includes a condenser for the steam and a flow regulator supplying condensate to a purity meter. These are connected in a closed-circuit under vacuum so that there is a continuous withdrawal of steam from the system with a corresponding return of condensate. The withdrawal of the steam is ensured by the condensation of the steam in the condenser effecting a higher vacuum in it than in the system from which the steam is withdrawn. In Fig. 4 the system from which the vacuum steam is drawn is represented by a main steam pipe (1) which may, for instance, connect an evaporator with a main condenser. In such a system the vacuum in the main condenser is slightly higher than that in the

main steam pipe so that steam flows continuously towards the main condenser, as indicated by the arrow. In a particular example the steam may be assumed to be under a 95 per cent. vacuum and at a temperature of 92 deg. F. For the purposes of purity measurement steam is withdrawn from the main pipe (1) by

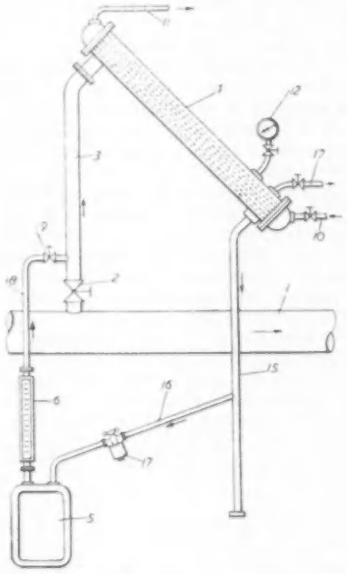
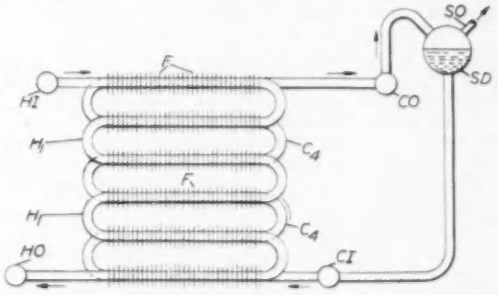


Fig. 4. Brit. Pat. No. 813,844.

way of an outlet valve (2), passing up a pipe (3) to the upper end of a surface condenser (4). The condenser is arranged with its axis inclined to the horizontal, at an angle in the region of 45 deg., and the condensate which collects at the bottom end provides a head which controls the rate of flow through a conductivity meter (5), and a flow meter (6). Cooling-water is supplied to the condenser by way of an inlet pipe (10) situated at the lower end of the condenser, and flows out of an outlet pipe (11) at the upper end of the condenser. The temperature of this cooling-water should be sufficiently below that of the vacuum steam in the main steam pipe (1) to ensure a constant flow of vacuum steam from the main steam pipe to the condenser. For this purpose the temperature of the cooling-water normally requires to be at least 20 deg. F. below the temperature in the main steam pipe. The rate of condensation of the steam in the condenser, of course, controls the vacuum at this point and therefore controls the rate of flow of steam into the condenser. The condenser is consequently fitted with a vacuum gauge (12). Condensate from the lower end of the condenser flows by way of a stand-pipe (15) and a further pipe (16) through a filter (17) to the conductivity meter (5). Any air or gas tending to collect in the surface condenser (4), and which would reduce the rate of cooling of the steam and therefore the vacuum in the condenser, is extracted through a pipe (17) connected to the steam-jet air-ejector of the main condenser of the system. The continuous flow of condensate through the conductivity meter (5) enables a continuous reading of the purity to be provided, and after flowing upwards through the flow meter (6) the condensate passes through a pipe (18) and then via a needle-valve (19) to the pipe (3), and then back to the main steam pipe (1). By adjustment of the needle-valve (19) the rate of flow of the condensate, as shown by the flow meter (6), may be adjusted to suit the rating of the conductivity meter (5). It is, of course, essential, as previously mentioned, that the condenser (4) shall be situated at such a level in relation both to the point of return of the condensate to the system, and to the flow meter (5), as to provide a head of condensate to ensure continuous flow through the conductivity meter (5); this rate of flow being controlled by the needle valve (19). As shown, the conductivity-meter (5), together with the flow-meter (6) and also the filter (17), are situated below the main steam pipe (1) in order to ensure that when the equipment is not in use these parts are always kept filled with condensate. This eliminates the possibility of air leaking into this part of the circuit when it is not in use, and thus interfering with re-starting. *British Patent No.* 813,844 *issued to Evershed and Vignoles Ltd. Complete specification published May* 27, 1957.

Heat exchanger

This invention is concerned with heat-exchangers of the type in which the two heat-exchange fluids are circulated in tubes, and the heat transfer takes place through metal plates connecting the two sets of tubes. It is particularly concerned with the case in which one of the heat exchange fluids has a very high thermal conductivity such, for example, as liquid sodium or potassium or other liquids or liquefied metals or alloys. According to the invention, the heat-conducting plates between the tubes are made of copper and are metallically bonded to the tubes by means of silver solder or other brazing metal having a melting temperature below that of copper so that there is a completely uninterrupted metallic path between the two heat-exchange fluids. A steam boiler in which water is evaporated by a hot metal such as sodium, by being heated in a heat-exchanger constructed of finned tubes in accordance with the invention is shown in Figs. 5, 6 and 7. In this boiler, a hot fluid (assumed to be liquid sodium)



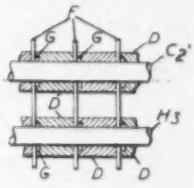


Fig. 5. (Top, left).

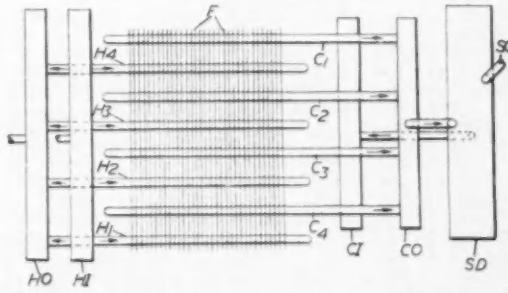


Fig. 6. (Bottom, left).

Fig. 7. (Above). Brit. Pat. No. 813,243.

is circulated from an inlet header (HI) to an outlet header (HO) through four coils (H1 to H4) lying side-by-side in parallel planes. Water from a steam drum (SD) flows to an inlet header (CO) through four coils (C1 to C4) lying alongside the coils (H1 to H4). The outlet header (CO) is connected to the steam space of the drum (SD) which has a steam outlet (SO). The coils (H1 to H4) and (C1 to C4) form a heat-exchanger having six passes, each pass consisting of eight tubes in the same horizontal plane, which are alternately hot and cold tubes. The eight tubes of each pass are connected together by fins (F) which are bonded to the tube in the manner described above. Fig. 7 shows two tubes (C2 and H3) which are in the same pass. They are connected together by fins (F) which are separated by distance pieces (D), each of which has in it a groove (G) in which the brazing metal was housed before the brazing process was carried out. *British Patent No.* 813,243 *issued to Foster Wheeler Limited. Complete specification published May 13th,* 1959.

Waste heat boiler

This invention relates to equipment designed to utilise the heat content of converter waste gases for producing steam. Proposals have already been made for cooling the waste gases which issue from the converter with an intense development of heat when it is being blown; it being suggested that the converter's flue walling be fitted with cooling surfaces. Since the flow of converter waste gases which is set up during blowing carries with it considerable quantities of dust which becomes deposited on the cooling surfaces, quickly forming solid incrustations of heat insulating matter on the cooling surfaces, the cooling action of the latter diminishes after a short time to a minimum value which, for practical purposes is no longer effective. Thus the fundamental conditions making for a practicable utilisation of the heat content of the converter gases are not present. The invention makes it possible to achieve a full utilisation of the heat content of converter waste gases without any danger of the cooling surfaces becoming incrusted, with a consequent reduction of their effectiveness. In Fig. 8 a converter (1) is shown in the blowing position. In this position the converter mouth (2) is directed towards the inlet opening (3) of a chamber (4). The chamber (4) is lined with cooling surfaces (5) through which a cooling medium passes. A baffle-plate (6) is positioned in the path of the converter waste gases streaming during blowing through the inlet (3) into the chamber (4), from the converter mouth (2). The baffle-plate (6) is so positioned in the chamber (4) that the converter waste gases strike the cooling surfaces (5) of the chamber (4) only after flowing around the baffle-plate (6). The surface of the baffle-plate (6) directed towards the flow of the converter waste gases, is more or less flat and smooth. The cooling pipe system of the baffle-plate (6) can take the form of a cooling coil, or as shown in Fig. 9, it can comprise a bank of cooling pipes (7), the ends of which are connected to inlet and outlet manifolds (8 and 9) respectively, embedded in a cast metal casing. The coolant is fed in and out of the pipe system through inlet and outlet lines (10 and 11), connected to the manifolds (8 and 9) respectively. Fitted underneath the chamber (4) is a dust-removal funnel (12) into which the dust particles from the converter rebounding from the baffle-plate are deflected, and from which they are drawn off. The converter waste gas, still at a high temperature, emerges from the chamber (4), and is fed to a regenerator (13). At the outlet side of this regenerator, in the direction of flow of the gas, are fitted subsequent cooling surfaces (14). An induction fan (not shown) provides —in the period of time between two refinings—for the passage of air past the regenerator (13) in which it is increased in temperature prior to reaching the subsequent cooling surfaces (14). *British Patent No.* 814,783 *issued to Schmidt'sche Heissdampf-Gesellschaft m.b.H. Complete specification published June* 10, 1959.

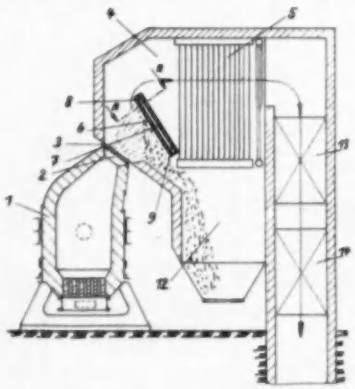
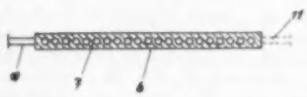


Fig. 8 (above). Fig. 9 (below). Brit. Pat. No. 814,783.



Feedwater controller

Fig. 10 shows a diagrammatic layout of a feedwater supply control apparatus for a steam boiler constructed in accordance with the invention discussed here. The steam boiler (1) is provided with a water-level feed control device comprising a metal thermostat tube (2) mounted in an inclined position at or about the desired level of the water in the boiler. The lower end (3) of the tube (2) is anchored to a suitable support, and this end of the tube is connected by a pipe, including a vertical portion (4), to a suitable point in the lower part of the water-space of the boiler through a valve (5). A drain valve (6) is provided on the vertical pipe (4). The upper end of the thermostat tube (2) is connected by a pipe (7) with the upper part of the boiler steam space through a valve (8) and a Y connection (9). A second metal thermostat tube (10), of the same general construction and dimensions as the first tube (2), is mounted in an inclined position above the general level of the water in the boiler. The lower end (11) of this second tube (10) is anchored to a suitable support and the upper end of the tube or a suitable point near its upper end is connected by a pipe (12) to the upper part of the boiler steam space through a valve (13) and the connection (9). The lower end of the second tube (10) is connected by a pipe (14), formed as a U-tube and conveniently including a vertical portion (15), through a valve (16) to a point in the boiler

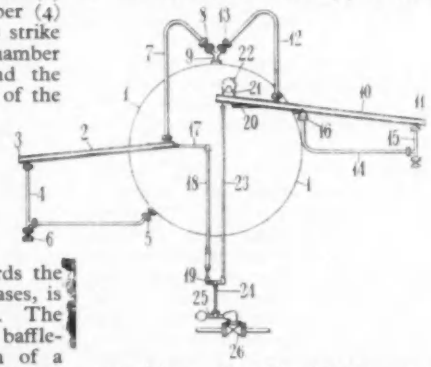


Fig. 10 (right). Brit. Pat. No. 814,017

steam space at a lower level than the top connection (9), but above the general level of the water in the boiler. This point of connection is arranged on a level with the upper portion of the inclined thermostat tube (10). The first thermostat tube (2) is provided with the usual bell-crank-lever pivoted on its support, the shorter arm of the lever being connected to the displaceable end of the tube (2) and the longer arm (17) being connected by a link (18), or other motion transmitting means, to one end of a floating lever (19). A similar pivotally-mounted bell-crank-lever has its shorter arm connected to the displaceable end of the second thermostat tube (10) and its longer arm (20) connected by a cable or chain (21) passing over a pulley (22) to a link (23), or other motion transmitting means, to the other end of the floating lever (19). An intermediate point on the floating lever is connected by a link (24), or similar means, to a pivoted and counter-weighted lever (25) arranged to actuate a boiler-feed regulating valve (26). The arrangement is such that the water-level in the first thermostat tube (2) corresponds to the boiler water-level, and any change in the latter results in either an expansion or contraction of the tube, the motion of which is magnified by the bell-crank-lever and transmitted through the floating lever (19) to the valve-lever (25) to either open or close the valve, and thereby maintain the desired level of water in the boiler. Steam which enters the second thermostat tube (10) is condensed, and water fills the U-tube connection (14 and 15) from the lower end of the inclined tube. The level of water in this inclined thermostat tube (10) will be at the level of the connection (16) of the U-tube with the boiler, and remains constant irrespective of changes in the boiler water level. Thus expansion or contraction of the thermostat tube (10) only occurs when there is a change in boiler pressure, and therefore in the temperature of the steam; and the tube displacement occasioned thereby will be the same as that of the first thermostat tube due to the same change in boiler pressure. These two tube displacements are transmitted in opposite directions to the floating-lever (19) by the arrangement described, and consequently no motion is transmitted to the valve operating lever. Thus any movement of the first thermostat tube due to variations in boiler pressure is compensated by the above arrangement and the supply of feedwater to the boiler, as controlled by this valve, will be correctly regulated in accordance with changes in boiler water-level to maintain the latter within the desired limits. *British Patent No. 814,017 issued to Copes Regulators Ltd. Complete specification published May 27th, 1959.*

X-ray Unit for Boilerworks

To enable the manufacture of all-welded steam boilers to be carried out at their Newark works, Farrar Boilerworks Limited have recently installed a new X-ray unit for the radiographic inspection of welded joints on test pieces and specimens. Work which could not, until recently, be carried out on pressure-vessels, because of the more exacting Class 1 specifications, can now be undertaken. This is the second important item of equipment installed at the company's Newark works in the past year; the first was an automatic Fusarc high-lift boom-welding machine, with CO_2 gas shield, which has enabled Farrar to produce Lloyd's Class 2 work to Lloyd's Class 1 standards. The new 150-kV Newton Victor X-ray unit with 360° beam tube comprises a tube-head, control and water-cooler. The tubehead, which is supported on a gantry stand, consists of a high-voltage transformer, a filament transformer and X-ray tube housed in a cylindrical steel container insulated with sulphur hexafluoride. Adequate protection for X-radiation is provided for personnel, while controls for the equipment are operated from behind a lead screen which gives protection to the operator. The automatic-welding machine consists of a Fusarc automatic-welding head and control panel on a 17-ft. 6-in. long boom, which is fixed at one end to a motorised carriage, within a vertical framework. Extending from the welding head, at the other end of the boom, is a lay trough in which the operator can lie when welding external or internal seams of vessels. The machine is capable of carrying, traversing, and rotating a 12-ton vessel, and is suitable for the internal welding of vessels from 2-ft. 6-in. minimum diam., and the external welding of vessels from 12-in. to 9-ft. 0-in. diam. In this gas shielded process, carbon dioxide protects the molten weld metal from atmospheric contamination, the arc being struck between a consumable filler wire and the workpiece.

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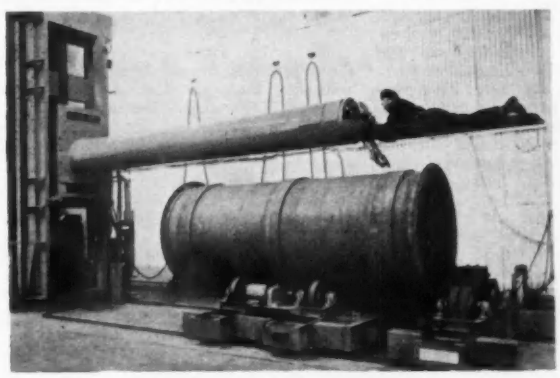
We have received from **The English Electric Co. Ltd.** two new publications. The first (ST/117) is a 40-page brochure describing the company's non-reheat steam turbines of 10-MW rating and above. The principal characteristic design and constructional features of single and multi-cylinder units are considered in detail. Illustrations include a number of sectional arrangement drawings of complete turbines and components. The second publication (ST/121) is a 12-page brochure describing English Electric geared steam turbo-generating sets of the condenser type, with outputs from 750-kW to 5,000-kW.



The automatic "Fusarc" high-lift boom-welding machine installed at the Newark works of Farrar Boilerworks Limited.

After serving for 33 years with the John Thompson group of companies, at Wolverhampton, **Mr. G. A. Plummer,** M.I.Mech.E., M.I.Mar.E., M.A.S.M.E., a main board director since 1955, and a director of John Thompson Water Tube Boilers Company for the last 20 years, retired at the end of May. Mr. Plummer's first senior appointment was as a deputy-director of John Thompson Water Tube Boiler Company in 1931, since when he has been largely responsible for the research into, and the development of, the water-tube boiler plant for which his company has become internationally known. Much of the development in Britain, of La Mont forced-circulation and controlled-circulation boilers, and of the "Etaflo" boiler is attributed to Mr. Plummer. He is a director of La Mont International Association Limited, and of the La Mont Steam Generator Limited; these directorships he is retaining. During the last few years, Mr. Plummer has been directly concerned with the nuclear power plant division of the company. He was closely associated with production of the stainless-steel vessel and the primary and secondary heat-exchangers for the Dounreay fast-breeder reactor, built by John Thompson for the United Kingdom Atomic Energy Authority. Up to the time of his retirement, Mr. Plummer was specially concerned with the design and construction problems presented by the steam-raising equipment for Berkeley nuclear power station.

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NOTES Personal AND Industrial

Sir Josiah Eccles, C.B.E., M.M., D.Sc., M.Inst.C.E., M.I.Mech.E., M.I.E.E., deputy chairman of the Electricity Council, has been elected president of the Electrical Development Association for the year 1959/60. Messrs. **A. W. Ferguson,** M.C., C.A., former chief administrative officer, Electricity Board for Northern Ireland, and **John Mould,** O.B.E., A.M.I.E.E., former chairman, East Midlands Electricity Board, were appointed vice-presidents for the term 1959-1962. At the first meeting of the Association's newly constituted council, **Mr. T. E. Daniel,** M.Eng., M.I.E.E., A.M.I.Mech.E., chairman of the North Western Electricity Board, was elected chairman for the year 1959/60, and **Mr. D. B. Irving,** B.Sc. (Eng.), M.I.E.E., chairman of the London Electricity Board, was elected vice-chairman.

* * *

W. H. Allen Sons & Co. Ltd., Bedford, who have recently established a branch office in Scotland, announce the transfer of the branch to new premises at 234, St. Vincent Street, Glasgow, C.2 (telephone No. Central 5906/7). The company's complete representation and service arrangements for the whole of Scotland will be handled from this office, under the managership of **Mr. Henry Winter.**

* * *

Mr. Cargill S. Sandeman has been appointed a director of Mavor & Coulson Limited, Mr. Sandeman's appointment is that of engineering director, with reference to production and development.

* * *

Mr. H. D. Crofits, chief designer, has retired from the Willesden works of the Lancashire Dynamo and Crypto Limited, after completing 49 years' service with the company.

* * *

Mr. G. S. Parish has been appointed sales manager, London Area (including Home and Eastern counties) of The David Brown Corporation (Sales) Ltd. Mr. Parish, who will be responsible for the sales of gear, foundry, machine tool and precision tool products in those areas, will operate from the company's London office, 96/97, Piccadilly, London, W.1.

* * *

The Minister of Power has reappointed **Mr. J. F. Beaver,** O.B.E., J.P., Shipley, Yorks., as a part-time member of the Yorkshire Electricity Board. **Mr. J. C. M. Maclagan** will retire from the board on May 31st, on completion of his present term of office.

* * *

After 40 years' service with The General Electric Co. Ltd., **Mr. M. R. Neville,** manager of the Publicity Organisation, retired at his own request, on June 30th, 1959. **Mr. A. C. V. Clarkson** has been appointed to succeed **Mr. Neville** as manager.

Mr. C. T. M. Bagnall, publicity manager of the English Electric Co. Ltd., has been elected chairman of the Publicity and Exhibitions Committee of the British Electrical and Allied Manufacturers' Association for the session 1959-60, and **Mr. G. M. C. Peacock,** A.M.I.E.E., manager, Publicity Department, Babcock & Wilcox Limited, has been elected vice-chairman.

* * *

Mr. H. Elly has been appointed regional fuel supplies officer of the Eastern, London and South Eastern Region of the C.E.G.B. Since 1955 Mr. Elly has been coal and shipping officer and ash marketing officer in the London Division, having previously been a group accountant since 1948. Before nationalisation he was chief administrative officer and accountant with the High Wycombe electricity undertaking.

* * *

Mr. D. H. Hill, of the U.K. Atomic Energy Authority, has been appointed resident nuclear energy attaché to **Mr. A. H. Tandy,** the U.K. Government's representative to the European Atomic Energy Community (EURATOM) in Brussels. The nuclear attaché will act as adviser to the U.K. representative and will keep in touch with nuclear developments in all the six member countries of EURATOM. Mr. Hill, has been a member of the staff of the Authority's Industrial Group since 1956.

* * *

Mr. I. H. Gordon has been appointed assistant sales manager of Cambridge Instrument Co. Ltd., at the company's head office in London. This appointment is part of the expansion of the sales organisation. Mr. Gordon will provide additional liaison between head office and the company's 10 branch offices, and will assist sales promotion generally.

* * *

Mr. C. E. Wrangham has been appointed joint managing director of The Power-Gas Corporation Limited.

* * *

One of the subsidiary companies of the Simms Motor & Electronics Corporation, East Finchley, London, N.2., **R. F. London & Partners Limited** are to supply heavy-oil burners of their manufacture for installation in the I.T.V. building in Norwich, and burners for the boilers in two new Liverpool ferry boats. The first of these orders comes from Messrs. Young, Austen & Young and the second from Messrs. A. J. Riley & Co. Ltd., of Batley, Yorks., manufacturers of the Swiss-designed Hoval boiler.

* * *

With the acquisition of the lease of No. 14 Grosvenor Place, London, S.W.1, the **Cambridge Instrument Company's** headquarters have been extended, thus providing enlarged sales facilities and better attention to customers and correspondents. The official address will remain 13, Grosvenor Place, S.W.1.

Eighteen standard or full courses have to date been held at the **Harwell Reactor School,** and Standard Course No. 19 will start on August 31st and continue until December 18th, 1959. Altogether, 951 students from 32 different countries have so far attended these courses, which began in September, 1954, and are designed to train engineers in the techniques of reactor construction and operation, particularly in connection with nuclear power stations. Half the places at each course are allocated to overseas students, and a fee of £250 exclusive of accommodation is charged. A special course for senior technical executives will be held from September 21st to October 1st, 1959. This is the ninth course of this kind and the fee is 50 guineas exclusive of accommodation. Application forms and details of both courses can be obtained from: The Principal, Reactor School, A.E.R.E., Harwell, Didcot, Berks.

* * *

Owing to the decreasing demand for the company's products at economic prices, the management of **Weir Foundries Limited** announce with regret, their decision to complete the closure of their foundries at Thornliebank forthwith. Redundancy of approximately 90 workpeople is being treated on a length of service basis. Of this number, those with over 10 years' service are being offered alternative casual employment. Efforts are being made to interest other industries in the use of the factory buildings, and the Weir Group are also giving serious consideration to this. Strenuous efforts are being made to attract new industry to this modern industrial site.

* * *

Negretti & Zambra Limited, 122, Regent Street, London, W.1, have made available a Portuguese language edition of their general catalogue. This was prepared specially for the British Trade Fair in Lisbon, where the company exhibited indicating, recording and controlling instruments for all industries, together with instruments for the measurement and control of temperature, pressure, humidity, volume flow, etc.

* * *

An order valued at approximately £400,000 has been placed with **The General Electric Co. Ltd.** by the Central Electricity Generating Board for the whole of the equipment for a nine-bay extension to the 132-kV substation at Willenhall. Also included are the replacement of seven existing circuit breakers by new circuit-breakers of higher rupturing capacity, and provision for the future addition of seven further bays. The 16 circuit-breakers will be of the bulk-oil type, pneumatically-operated and rated at 3,500 MVA. Although standby local control panels are being installed, Willenhall will normally operate as an unattended station remotely controlled from Walsall.

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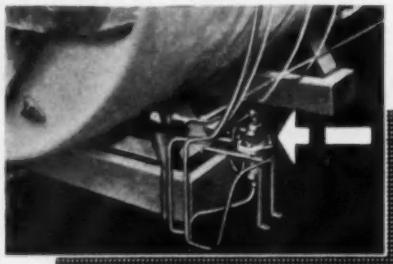

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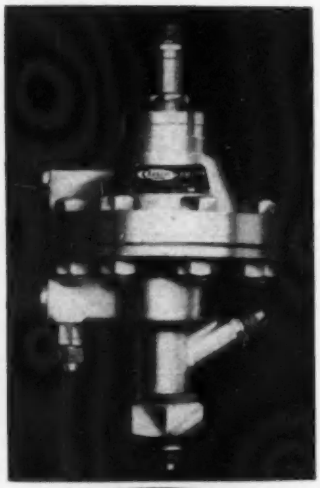

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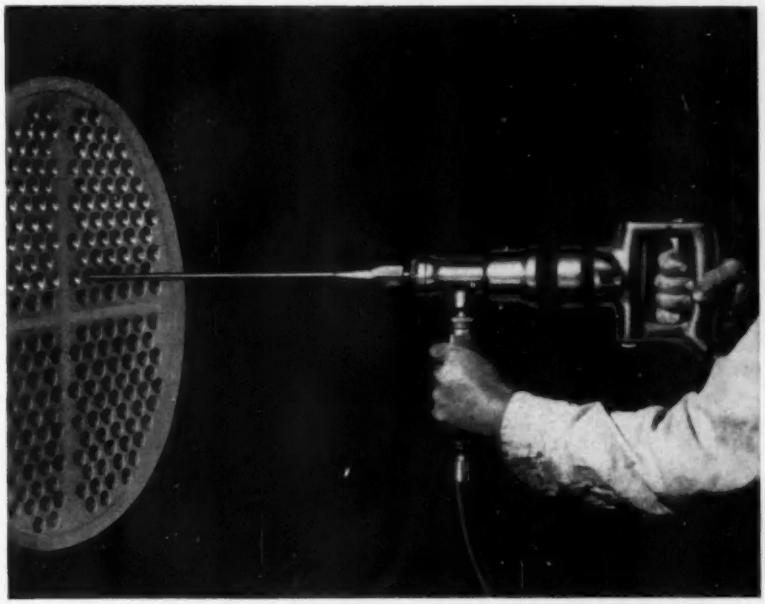

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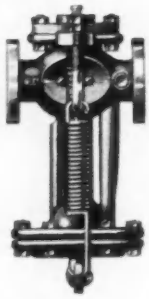

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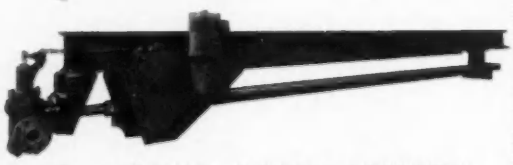

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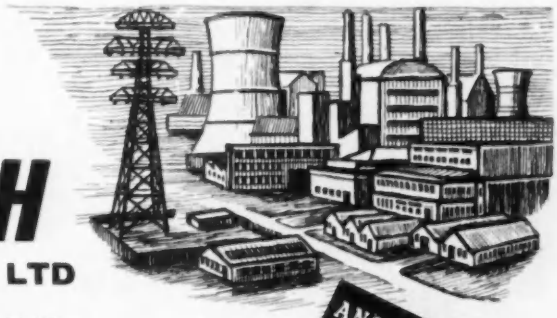

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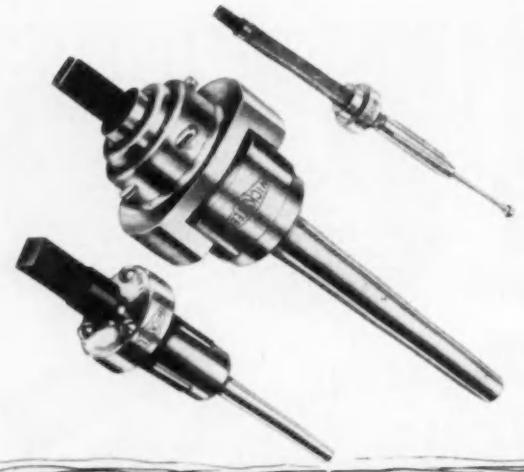

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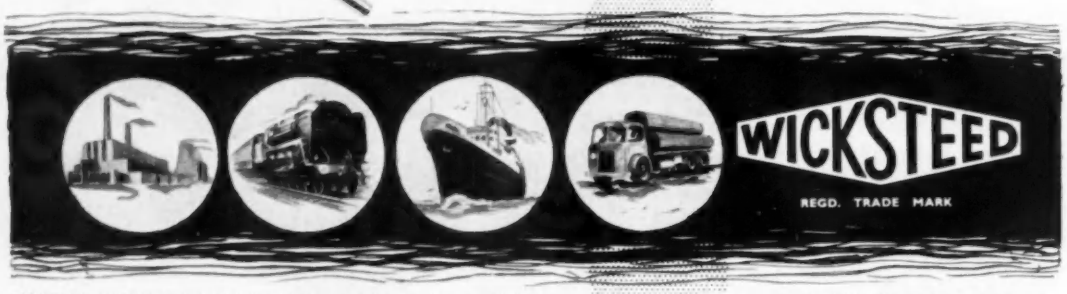

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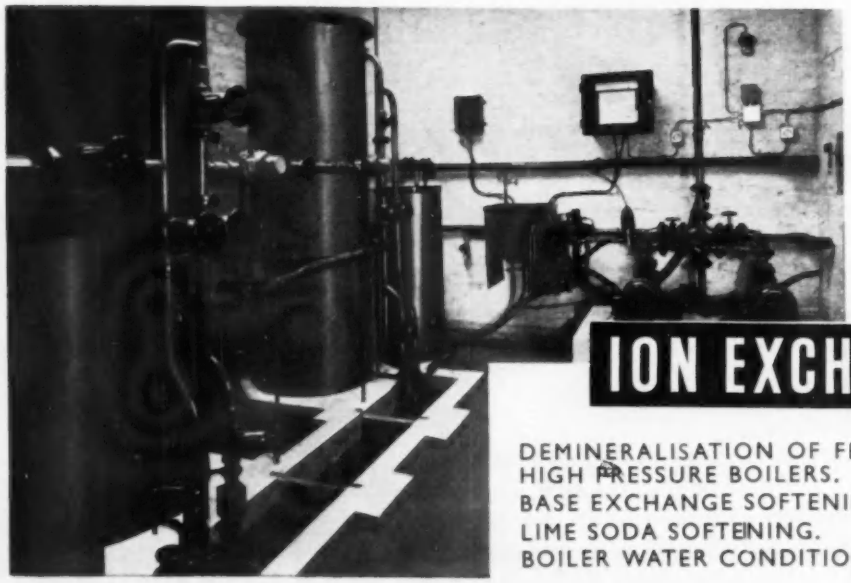

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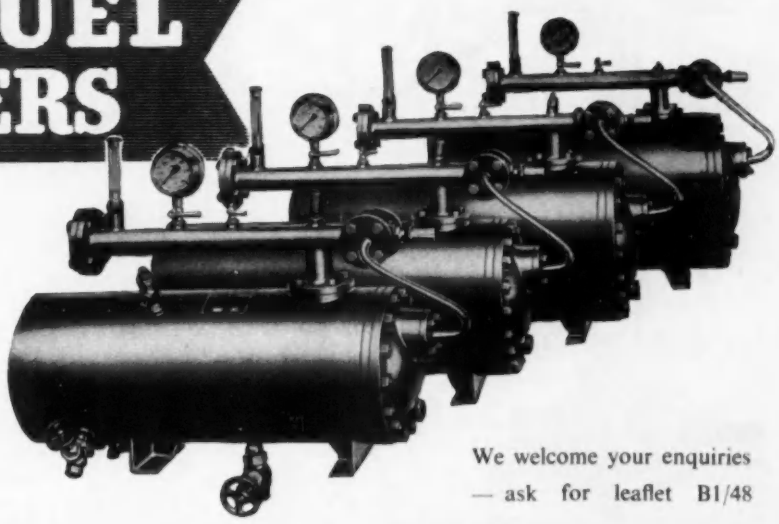

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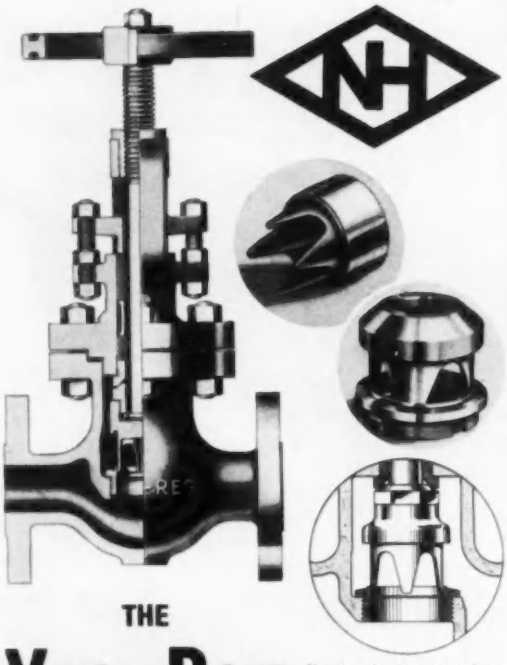

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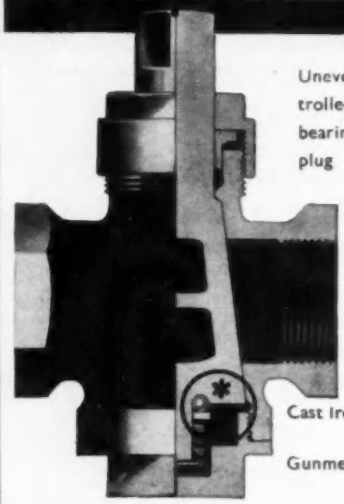

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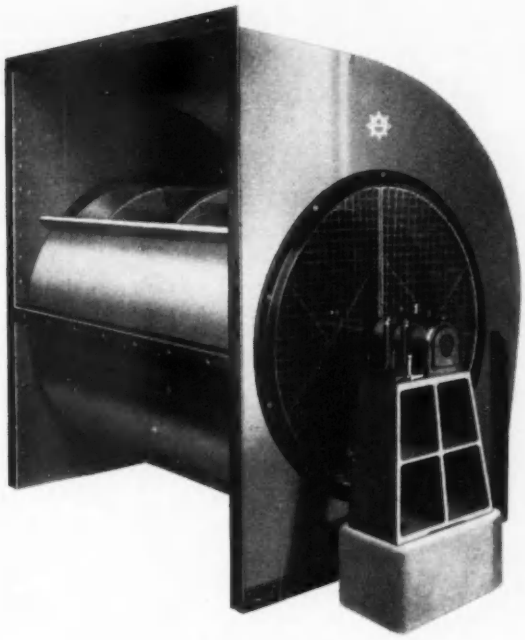

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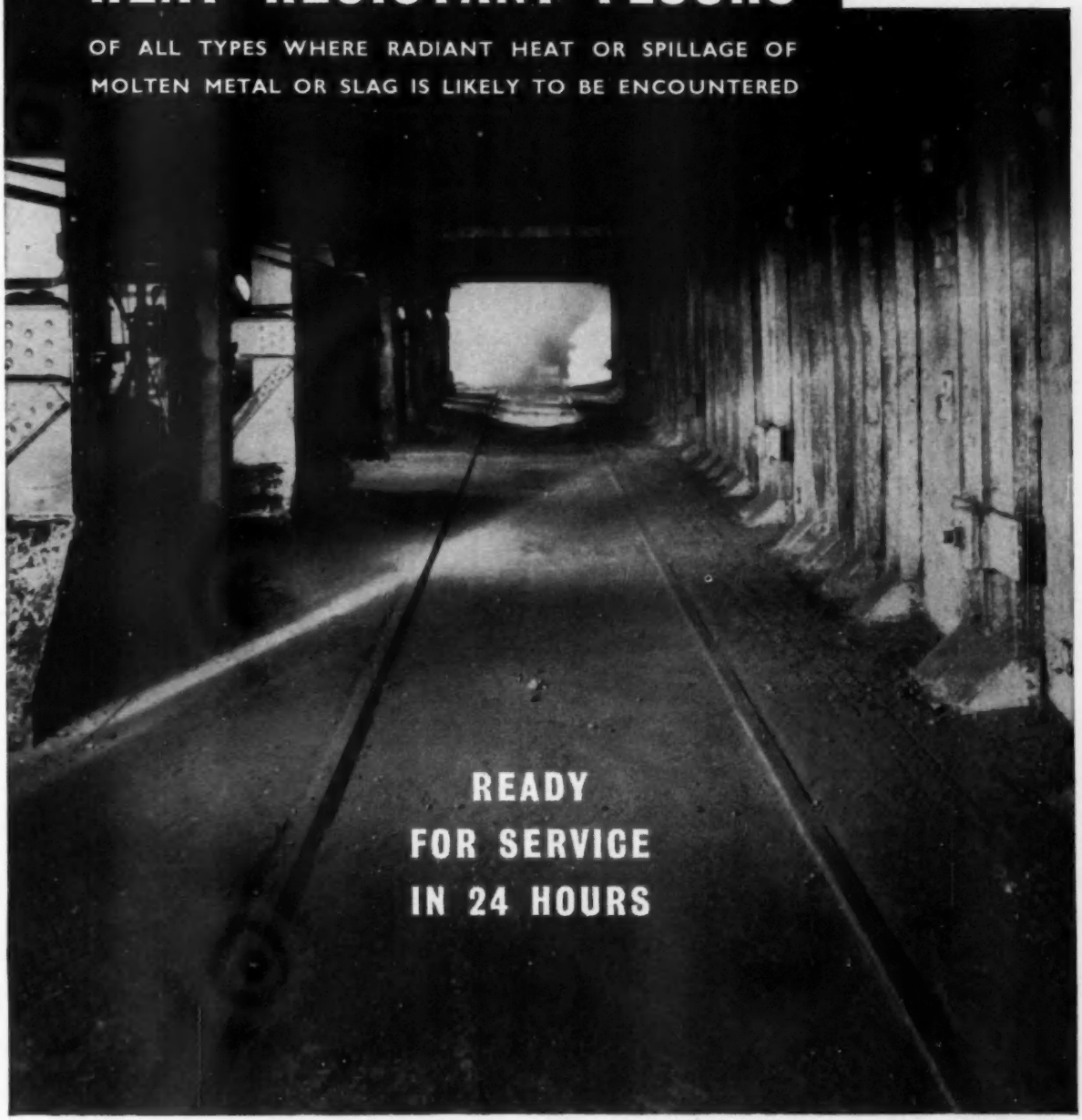

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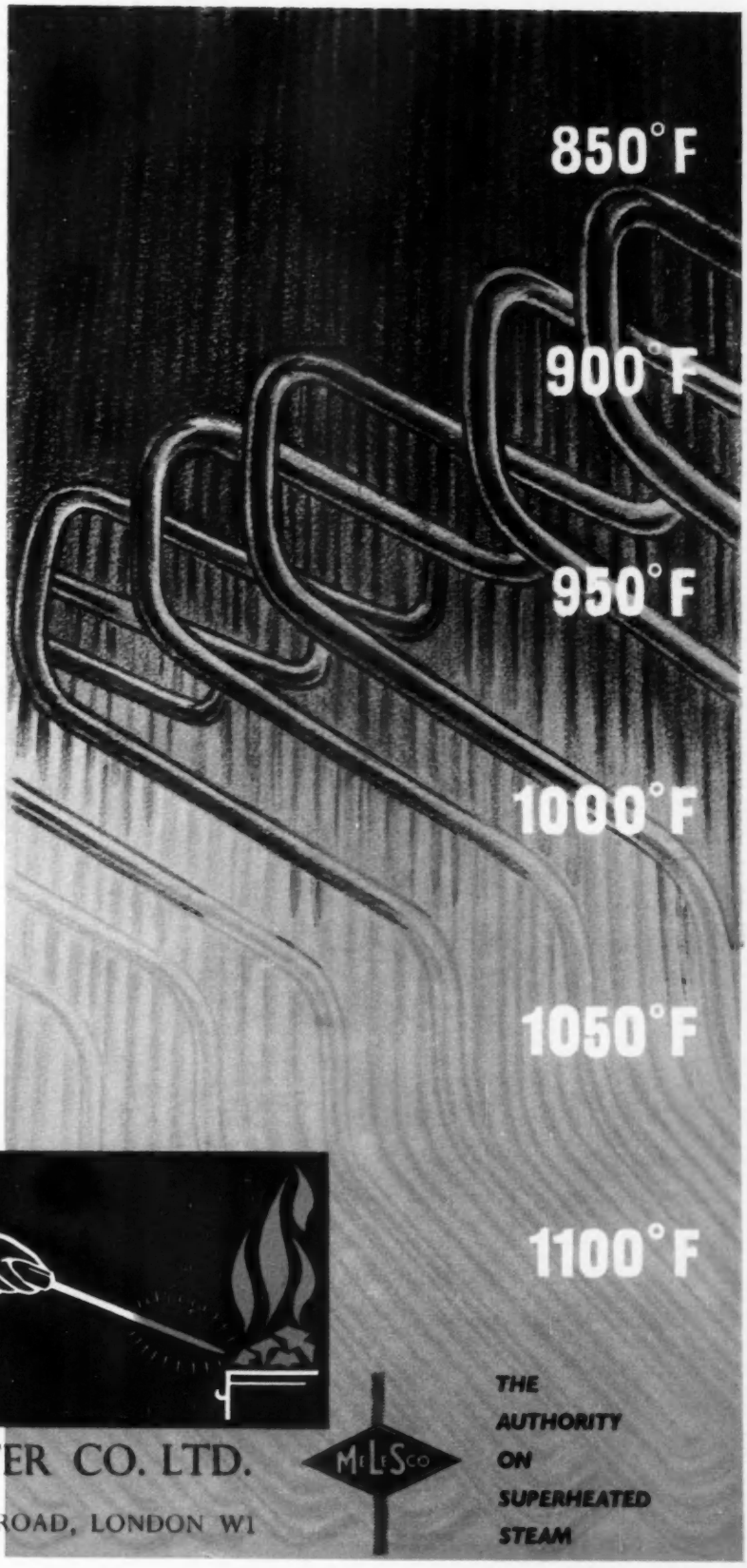

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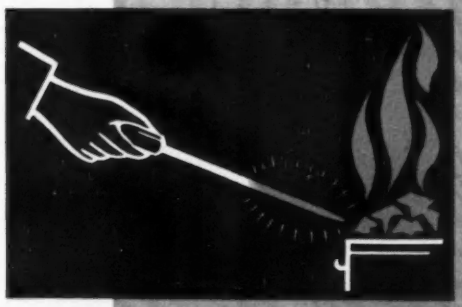

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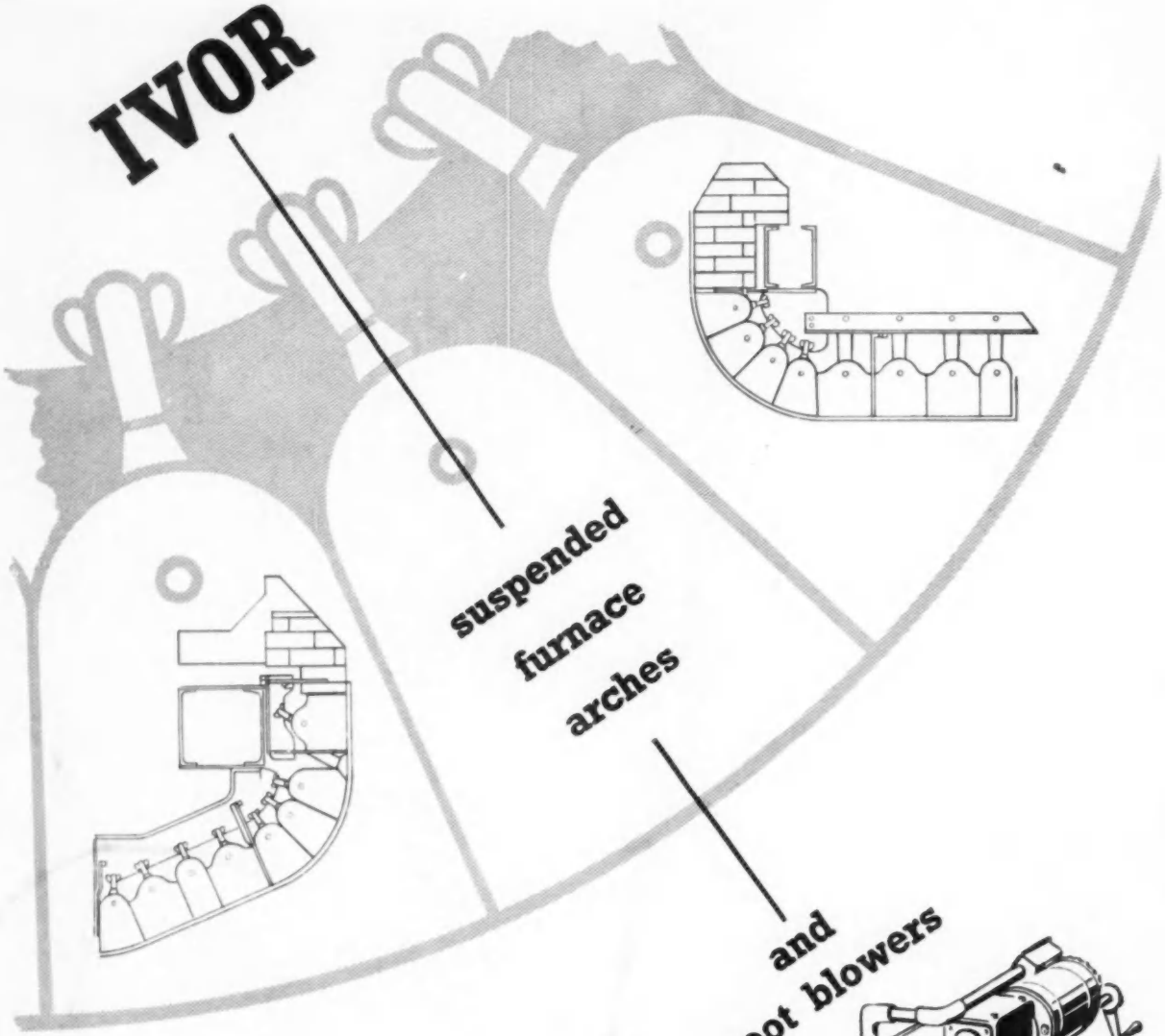

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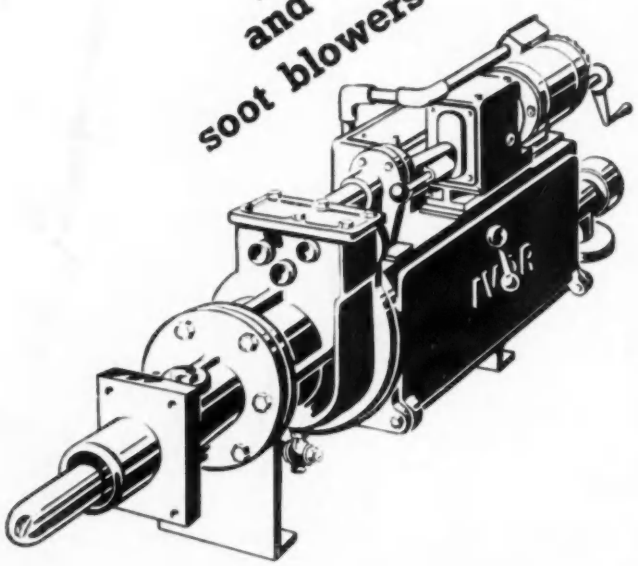

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